城市穿戴着我们
—— 关于分布式传感和感知范围的说明

本杰明·布拉顿

The City Wears Us. Notes on the Scope of Distributed Sensing and Sensation

Benjamin Bratton

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TECHNOPHANY

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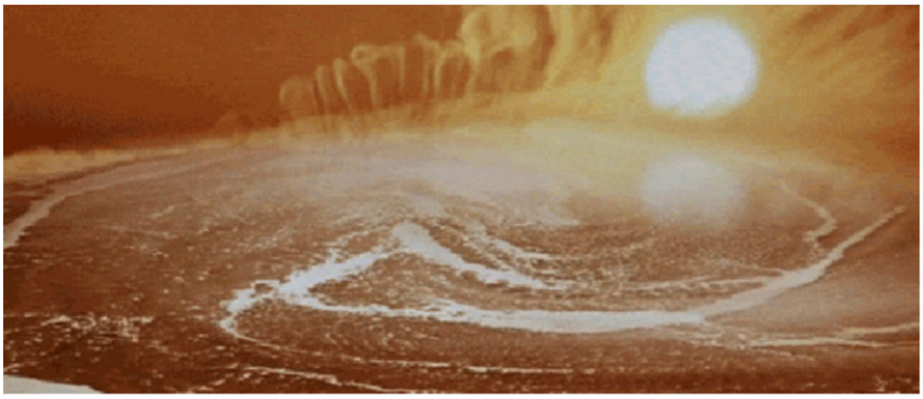
设计师们正剪裁着这件有感受力的衣服，听起来有点疯狂。它是生活在未来废墟上的服饰，结合了各种人工智能、嵌入式工业传感器、嘈杂的数据、数以千万计的金属和水泥器械，或动或静、数以十亿计的手持玻璃板电脑、亿万计的人类远祖，以及一团云端材料所交织出的抽象模型。一个神秘的自动化管弦乐队在这不均地形中融合而成，其创造力和残酷性令人惊异：像是个内外倒错之洞穴，又如史坦尼斯劳 · 莱姆（Stanislaw Lem）的索拉里斯之海，一座等离子之城。（“智慧城市”则是与此不同的愿景。虽然工法相似，但它梦想一种全知的市政，赞美功能论和系统优化。在这件新装内，早期以居住、工作、生活的循环所绘制的现代城市计划被重新分类，但在智慧城市这里，它们被具体化和强化，人们便将它的变量当成是控制。）



安德烈 • 塔可夫斯基导演的《索拉里斯星》中，剥削恐惧的一片黏性物质是潜意识的星际海洋，1972

我想把这种服装的可穿戴性看作一层皮肤。既然拓展，寓言化我们的视觉的，是无数城市规模的机器感知，回来关注皮肤似乎有点奇怪，但它其实是我们最大的感官器官。我们已经拓展了合成视觉和合成听觉，但现代媒体在表皮感知的增强上则有待多加着墨（不过最近有多了一些）[1]。皮肤技术终归是人类的一部分。皮肤并没有随着我们的迁移而进化，我们倾向于用科技打造专用的临时性皮层，抗热、抗寒、防水、用在仪式戏剧、伪装、或传达角色等。随之而来的个人打扮和招蜂引蝶便是基于人们如何在地读解这

1 参阅本杰明•H•布拉顿（Benjamin H. Bratton），“与皮肤相关的问题”，第46期《家居（shelter）》（2015年12月）印发。

些人造皮肤，全球时尚和纺织品营销行业因此而生。在更功能性的层面上，合成皮肤将环境调节成所谓不温不火的良好状态[2]。但这不仅仅关于我们。城市感知也让城市表皮感知它自身所处的环境（人事时地物）。接着，城市尺度的人工智能世界进行感知、反应和索引的方式与其说是遵照“培养皿中的人工智能”模型，不如说是在被野放中[3]。如此，一种非常态而且名副其实的“分布式认知”于焉形成，感知世界和信息处理之间早就开始消融的边界如今变得更加模糊。

比起堆砌一系列指令链的，去追问某义肢为何物，更可以帮助我们打开许多观点[4]。当我们的身体穿戴上皮肤，当我们的建筑在泡沫大气层的切肤包裹下（斯洛特戴克［Sloterdijk］就会如此形容），这种秩序安排的自然化就会被打乱，城市感知看似是达到一种原初知觉。但人其实不仅仅是某些现象学核心意义下的维特鲁威式演员：这种观点认为人穿戴着建筑;但其实事物也穿戴着人们。我们就是我们所穿着的皮肤。衣服裁剪和缝制，不仅是为我们所穿，*城市也穿着我们*。

城市感知和敏感性

此话不是对未来的预言，而是陈述现实。所以，在此我不谈未来的感知形态，而是当下的感知地图。对人工智能最通俗的理解，并非基于原始信息的集合，而是基于从这些数据中得出的模式化印象，但是，任何起作用的智能，都是由它对其世界采取行动的能力来定义的，并且它的行动能力是由它感知世界，和自身如何身处其中的方式而构成。这里有一个也许十分特殊的，机器专属的情感理论需要我们在未来几年发展出来。

例如，无人驾驶汽车就是大型重型机器学习／感知街道的象征。它们的体感传感器包括轮速传感器、高度计、陀螺仪、视距仪、触觉传感器，而它的外部传感器包括多视光照相机、激光雷达测距、短程和远程雷达、车轮上的超声波传感器、全球定位卫星系统／地理定位天线等。若干系统在感知和解释之间有重叠，例如道路标志、特征检测和解释算法，即将到来的道路模型地图，以及车间交互行为算法。沿着从完全自动到部分自动的梯度，内部人员提供了另一个智能组件，该组件可以是副驾驶或货物，并且他们共同形成复合用户，漫步穿过堆栈的城市层。[5]

但是，感知和思维系统不仅仅在高价值的主体和相关物件中，他们还以多种镶嵌工艺内置于城市结构之内。因为，一座能感知的

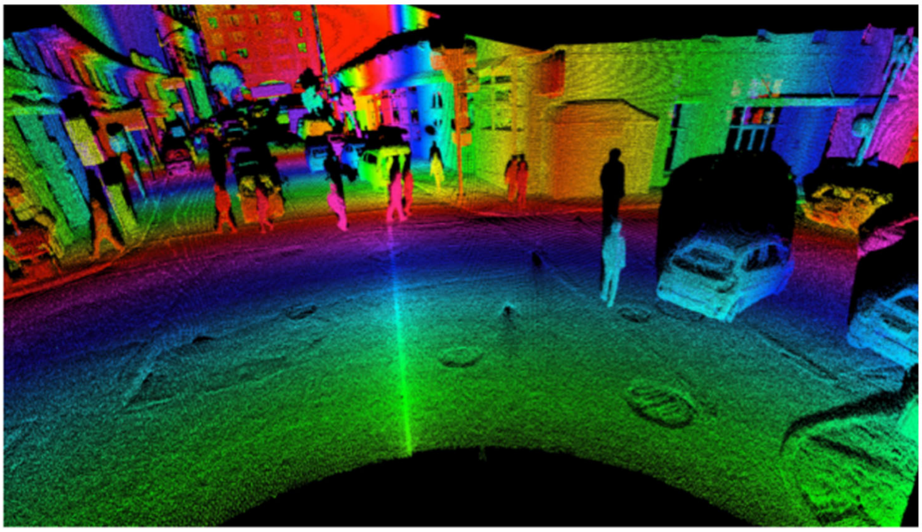
2 雷纳·班纳姆（Reyner Banham），《良好环境的建筑（The Architecture of the Well-Tempered Environment）》（1969），2013 年 Elsevier 出版社印发。

3 参阅本杰明·H·布拉顿（Benjamin H. Bratton），“敏感物质的地理分布：关于城市规模的人工智能（Geographies of Sensitive Matter: On Artificial Intelligence at Urban Scale）”。《新领域》（马萨诸塞州剑桥：哈佛设计研究生院，2017（即将出版）印刷。

4 参阅尤西·帕里卡（Jussi Parrika），“感知烟雾：智能无处不在的城市和感官身体（The Sensed Smog: Smart Ubiquitous Cities and the Sensorial Body）”，《纤维文化杂志》2017 第 219 期，网页版。

5 复合用户一词源自我的书《堆栈：关于软件和主权（The Stack: On Software and Sovereignty）》（马萨诸塞州剑桥：麻省理工学院出版社，2016）。用户是堆栈模型的一个层，也是该系统中任何能够与接口层交互的人或非人角色所占据的中介。复合用户由多个实体组成，它们与系统交互，就像单个实体一样。

城市，其思考方式与其感知方式是密不可分的，而一本好的目录与其说是扁平本体论（flat ontology）中的一长串物件，或新模型技术中设置的特征集，不如说是一种一连串功能的解剖索引，以及机械感知世界之初的限制规则。分布式的车身不仅包括汽车传感器，还包括数字组件传感器、流量传感器、湿度传感器、位置传感器、速率和惯性传感器、温度传感器、相对运动传感器、可见光传感器和记录“摄像头”的位置传感器、局部区域和广域扫描仪、振动传感器、力传感器、扭矩传感器、水和湿度传感器、压电薄膜传感器、流体属性传感器、超声波传感器、压力传感器、液位传感器等。从更为全景的角度看，低地球轨道的遥感系统与陆地网络交错，依次上下描绘数据。遥感地质观测可以利用摄影测量、多光谱系统、电磁辐射、航空摄影、热红外传感、主动和被动微波传感及不同数值范围的激光雷达等技术来观测水体、植被、人居环境、土壤、矿物和地貌[6]。虽然其中许多已经是城市、工厂和地理区域的一部分，但是它们通过标准化的计算协议和网络（通过传统的物联网模型，或其他）与地形的整合意味着特定领域和更普遍的人工智能有一条走出实验室和走向大都市规模的演化机器人学说的道路。它们是怎么被穿戴的?



使用Luminar技术的Toyota自动驾驶汽车的激光雷达视角，2017

穿着性能

作为消费型电器的一个领域，可穿戴计算充其量只是在发展的早期阶段。目前这个术语指的是智能手表和传感器，可用来监测心跳或汗液中的血糖水平，或通过测序软件触发的衣服上闪烁的亮光。到目前为止，还不是很鼓舞人心的东西。然而，随着时间的推移，当微电子和信号处理层缩小并变得更加节能，“可穿戴设备”

6　这些技术的备用教科书是：约翰·R·延森（John R. Jensen），《环境遥感：地球资源视角（Remote Sensing of the Environment: An Earth Resource Perspective）》（培生（Pearson）出版社，2016）。詹妮弗·加布里斯（Jennifer Gabrys）在《程序地球：环境感知技术和计算星球的制造（Program Earth: Environmental Sensing Technology and the Making of a Computational Planet）》（明尼阿波利斯：明尼苏达大学出版社，2016），中提供了一个替代模型。

进一步扩张的领域可能会成为主流，就像移动计算脱离桌面计算一样。我们更感兴趣的是系统配置文件的小型化和扁平化如何使他们能够覆盖许多不同类型的皮肤：动物和植物皮肤、建筑皮肤、机器皮肤等。任何表面都可能是皮肤，我们可以设定各种灵敏度。例如，装配这些驾驶员的汽车的传感器阵列将进一步发展，组合和专业化。这些阵列的后代可以覆盖其他机器，运动的或静止的，熟悉的或不熟悉的。因此，穿着性能不仅适用于人类用户，甚至只是运动中的身体，也适用于任何有表面的“用户”。

就像一旦表面的感官能力变得更有活力时皮肤的界定会变化一样，当不同的皮肤被共享的传感器增强时，所谓的“穿着性能”也会发生变化。也就是说，这些传感器的灵活性和普遍性也是跨应用程序的组件和子组件平台化的功能，并且相同或相似的传感器跨不同表面的分布意味着极不同的身体共享相同的感觉系统。可贴在哺乳动物皮肤上的传感器版本，可以从装配线上的传感器谱系派生出来，如果我们认真对待技术进化的含义，那么这种传感器在不同真皮表面上的模糊和混合会尽量缝合半机械人就像器官的组装那样。

然而，关于可穿戴设备，目前人们推荐的功能只是运用了最一般的关键性能指标，和基于过时的社会环境所做的功能优化。这种自动管理主义并不是可穿戴计算最有潜力的发展方向，而应该是用户在彼此感知和被感知之间的奇怪连结，一种难以估量的生物符号学的发展。这些想象可能一下就不流行了，也因此仍是单独的一个个未经思考的片段，或者，它们可能会凝聚，并参与到我们用以对认识自身的深刻决断过程。

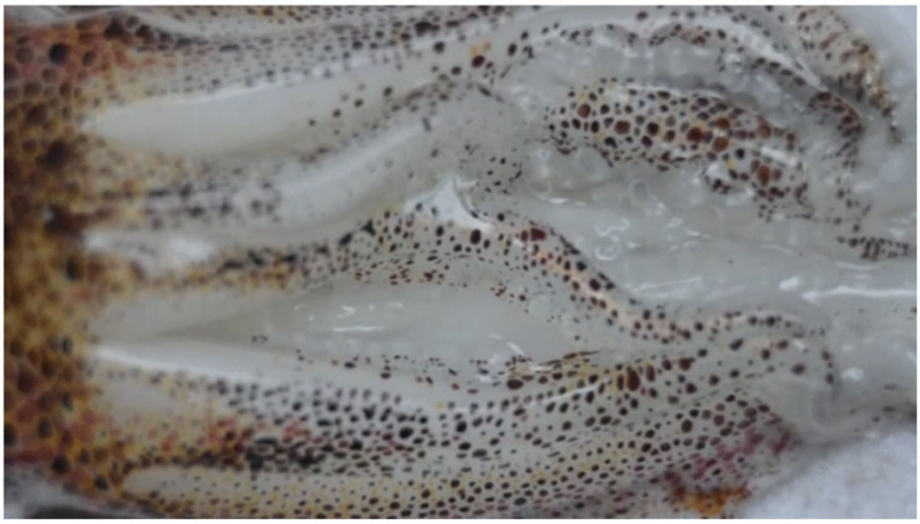
同时，我们对自己皮肤的传统理解将推动并缩减合成皮肤／可穿戴计算所要求的扩展范围。但是，我们迟早会遇到这样的现象：我们没有足够的词汇（就像我们对痛苦的语言是不完整的，对触觉也是失语的），我们现在生活的皮肤将会被新的术语重新创造出来。

穿上衣服

服装已经是一种合成的皮肤，它的功能不仅是热调节或防止擦伤，而是与其他人交流重要的亚文化信息，关于我们是谁，而不仅仅是我们是什么。这不仅仅是区分说红色和蓝色的衣服意味不同一件事，而是通过其微妙的语义，时尚产生了一种暂时的表型，在超语境参考的曲折迂回中互通信号：下摆的季节性形式，领子的大小，绿色的单调，T恤上的品牌／带子的钝角，以及构成项链的球体体积比，项链可能连接也可能不连接仅露出肩部的三角形褶皱。社会动力不仅由这种可塑性符号学来表示或执行，而且由它们直接和内

在地计算[7]。

我们并不是迄今为止唯一做这种事情的动物，不同的路径也吸收了其他形式的分布式认知[8]。当我们开发合成皮肤时，其他动物进化出了更复杂的、具有令人难以置信功能的天然皮肤。例如，墨鱼利用皮肤上的色素细胞来迷惑猎物，躲避捕食者，并与其他墨鱼交流。根据呈现的背景（环境），相同的反应可以起到不同的作用。（虽然乌鸦应该有种如同我们所称的实践心理理论，但我们并不会因此认为墨鱼也能够想象出它们的皮肤在另一个有机体看来是什么样子，所以称它们的“表现”闪闪发光可能是不准确的。如果是这样，那他们又会如何看待彼此呢？）重要的是，智力内在于皮肤本身。墨鱼的色素细胞和虹膜细胞瞬间调节，以产生与同构的神经元图案相对应的、令人眼花缭乱的复杂图案。当皮肤和大脑被绑定成直接回路时，我们可以说，膜的不可思议的动画与认知动作一样是一种神经反应。关于我们应该如何想象一个丰富的城市规模人工智能生态学，墨鱼的案例是深刻的。它不是戈达尔的阿尔法城的冷漠的中央处理大脑；它是一个分布更广，绝不是笛卡尔唯心主义的。智能在皮肤和我们设计的城市传感系统中，可能类似于露西·麦克雷（Lucy McRae）项目中提取的后墨鱼地形[9]。但是除了迷信的挑衅之外，传感和感觉的螺母和螺栓工程是什么呢？它的起始规模是多少？



鱿鱼伪装图案（色素体）。所有权利保留。

一切都是化学品

所有经济学都是生态经济学。毫无疑问，设计并不是在给定属性之上浮动的虚拟层。一些设计哲学在很久以前就理解了这一点，并且后阿西洛玛（post-Asilomar）生物技术的历史中充斥着推演式

7　这些边界语义由设计师进行探索，诸如川久保玲（Rei Kawakubo），侯赛因·查拉海恩（Hussein Chalahayn），艾里什·凡·赫彭（Iris van Herpen），和许多其他设计师。露西·麦克雷（Lucy McRae）将时尚作为平民主义合成生物学的先行形式，在个体生物之间演出掠夺行为并显示（进攻/防御/攻击/诱惑），并任由它们犹豫不决。尽管这些可能示意生物科技的自身形象，仅次于物种，但在别处，标准化美学（莱巴赫、沃尔玛、所有黑色衣橱）描述了一个易变的庞然大物。

8　参阅，例如，伊丽莎白·格罗斯（Elizabeth Grosz），《混沌、领土、艺术：地球的框架（Chaos, Territory, Art: The Framing of the Earth）》（纽约：哥伦比亚大学出版社，2008）。汉娜·罗斯·谢尔（Hanna Rose Shell），《隐藏与寻觅：伪装、摄影和侦察媒介（Hide and Seek: Camouflage, Photography, and the Media of Reconnaissance）》（马萨诸塞州剑桥：区域图书（Zone Books）出版社，2012）印刷。

9　更多麦克雷的成果，参看 https://www.lucymcrae.net

的生物设计概念、叙述和叙事模型，这些都为这些技术的伦理、生态和政治影响的讨论提供了信息[10]。生物科技遵循常规的政治分歧是有争议的，然而在这些问题上，人们有时会对神创论的余象产生担忧。从这个角度，我不是（必要）说世界上所有事物都是由一神论的个体创造出来的。更确切地说这是一种更分散的观念，世界不仅是动态的自适应系统，而是将抽象本质以实例化呈现给我们的特殊文本。此外，它认为，不污染那些形式（如凡达纳·湿婆［Vandana Shiva］传播的科学农业的神学启发禁忌）或否认系统的基本扰动确实是可能的（例如，参议员詹姆斯·因霍夫［James Inhofe］传播的神学启发的对人为气候变化的否认），就能更好地服务于这个秩序[11]。这些通常伴随着对人类狂妄自大和过度扩张的警告。我的看法完全不同。相反，生物设计的利害关系并不在于对自然的控制（真实或想象），无论是好是坏，而是在于将人体重新神秘化为流动的物质；生物设计所设计的这个主体，就是作为物质形式的生物和它所居住的材料。在这里，设计的限制基础是化学。

为何如此，又该如何？细想我们在圣地亚哥加利福尼亚大学D:GP帮助开发的Nanome项目[12]。它是一套基于VR的科学建模和设计工具，包括CalcFlow和NanoOne。简言之，你用虚拟数学来制造虚拟物理，你用它来制造虚拟化学，你用它来制造虚拟生物学。生物技术的应用和药物发现是第一批试验应用，但是，简化数学可视化的门槛，用以作为为分子建模的基础，其背后带有更根本的意义。生物技术的应用和药物发现是第一批试验应用，但是提供将数学可视化为分子建模的基础的更简单的方法具有更重要的含义[13]。与许多其他复杂的设计软件一样，我们看到用来增强和拓展形态搜索的机器学习系统的整合。在这种情况下，我们看见将设计查询和解决方案的累积用作生物科技研究AI的训练数据[14]。也就是说，人类用户的接口层（映射、建模和模拟材料过程的方法）是AI的输入层（一种构成机器学习系统的搜索空间的归纳和演绎的查询模式）。从这个意义上说，合成生物学可以被看作是应用人工智能的一种类型。这些可能一起支撑重大的突破（有朝一日：工业规模的合成光合作用和按需个体基因组定制的药物治疗等），并使生物化学的“烹饪唯物主义”更适用于流行的设计/黑客活动(希望是件好事)[15]。事实上，前者可能仅仅因后者而被证明是可能的。

我们认为我们对动物智能和植物智能有很多了解，但城市规模的人工智能在很大程度上是矿物智能。金属、二氧化硅、塑料和电磁雕刻在其中的信息构成了材料基础（但不是全部，我将在下面考虑）。反过来，人工智能是应用无机化学的一种。强调将任何AI在其自身世界定位的感知输入，我们看到，这种矿物质基础并不会将

10　1975年关于重组DNA的阿西洛玛会议为使用重组DNA的科学实验制定了指导方针，并为此后的此类研究提供了预防性框架。它被看作是公众对先进生物设计的安全和规范的认识和争论中的一件大事。最近，类似的首脑会议试图以不同和不确定的成功程度来表达（构架）CRISPR/Cas9基因编辑技术的发展。

11　蒂莫西·莫尔顿（Timothy Morton）将声称因果关系和美学是同一回事。参阅《现实主义魔法：对象、本体、因果关系（Realist Magic: Objects, Ontology, Causality）》（安娜堡：密歇根大学，2013）。可以说，这种对话由于文学或艺术批评的膨胀和范围蠕变蔓延到整个人文学科中并造成阻碍。正如彼得·沃尔芬代尔（Peter Wolfendale）所说，“一切事物都被当作一种符号，符号的联系可以自由地代替因果的联系。TJ·迪莫斯就是如何通过世界首选的“读数”来说明这会导致世界混乱的例证。例如，看看他作为艺术评论家的工作如何引导他提出关于生物技术、生态经济学、农业政策和食品供应基础设施的政治和项目的古怪的建议，这些被理解为我们可以“回应”的“碎片”。参阅他的言论，“超越伊甸园的生物美学生态未来主义和反乌托邦（Gardens Beyond Eden Bio aesthetics Eco futurism and Dystopia）”，第13个文件，（2013年6月18日），白色建筑（The White Building），网址：https://www.youtube.com/watch?v=TCnF1NQxTF-w&t=2893s。在这里，他对上述湿婆和唐娜·哈拉维的作品进行了恰当的清晰区分，但是从那里开始进入典型的唯我主义的死胡同。

12　请参阅Neimo.AI和Stimvr，其中两个应用程序的工作版本可供下载。

13　显然，化学的真正复杂性远远大于这些块状数字漫画，但它们的目的是功能抽象。这个设计工具的目的并不是要产生一个本体论上精确的物质的复合体。它提供了一支钢笔和一把扳手，用来制作可操作的模型抽象，作为实验室工作台工作流程的一部分。

14　从事人工智能与生物技术研究交叉的其他公司和项目包括Atomwise、Mendel.ai、GEA Enyzmes和A2A Pharma。

15　烹饪唯物主义”一词是从《瓦解7：烹饪唯物主义（Collapse VII: Culinary Materialism）》（英国法尔茅斯：Urbanomic出版社，2011）中借用的。

它从潮湿、炎热、热力学的世界肉体中抽离到一些干燥的真空中，而是恰恰相反。如果正如俄罗斯宇宙主义者尼古拉·费奥多罗夫（Nicolai Fyodorov）在一个多世纪前所推测的那样，我们就是这样被折叠的物质，通过地球的自我认知，然后这种折叠也可应用于其他类的物质，包括构成城市规模AI 感知 / 思维系统的有机化合物和无机化合物的混合物。

2017，沙特阿拉伯NEMO项目的太阳能电池板。
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模型的持久性

在试图准确描述AI在这种摺叠中能够及不能够定位的地方时，定义感知和思维之间的实际关系就显得尤为重要。休谟和康德争论中持久的线索又回来了：经验观察的感官是如何（以及最终是否）与“先验的”框架联系起来，该框架给予道德连贯性，及从被感知的事物到反思判断的更广泛推论，及最终现象的内在性。出于人工智能城市化的目的，我们可以暂时地，或许只是类比地，引用现代欧洲哲学中的这种基础划分，但是，在什么情况下工程感觉的无机化学项目必须具有“框架”之类的东西？或者，它是否可以凝结或逐渐拥有一个，如果如此，那将如何改变我们最初绘制这种框架的方式？

除了雷扎·内格雷斯塔尼（Reza Negarestani）的归纳和演绎认知模式制图之外，我们可以根据不同种类人工智能类型对此光谱两端的相对依赖程度来限定它们：高输入 / 少模型（归纳）少输入，多模型（演绎）。从广义上讲，通过基于对空间内局部和中间因果关系尺度的理解，给定问题空间模型的形式化构造，我们可以说，基于符号逻辑的旧的老式人工智能更多依赖于演绎手段。由于许多众所周知的原因，从数据和处理资源不足到逻辑符号化的自适应限制，这些方法与更归纳的方法相比已经失宠。例如，基于人工神经网络的深度学习

系统建立对输入语料库的功能响应，将向量划分成可识别的输出。对于这样的系统，无需系统生成任何类似于可识别的问题空间的形式化“模型”的东西，就可以实现对输入的功能响应。

然而，我们不能只从在现实世界中实现的人工智能系统中寻找这样的框架。但是，虽然深度学习过程的不透明确实暗示了有趣且外来的“思想”形式，但作为城市基础设施的实用设备，我们的人工智能系统并非没有显式或隐式的人类认知偏见，无论是积极的还是消极的。根据该术语的不同含义，在人工神经网络中确实需要权重和偏差来寻找特定模式的证据。但是，将输入数据组织成一个有用的语料库本身至少需要几个模型，包括文化模型，这些模型必然充满了异常的错误和语病。从这个系统的一种角度看，构成输入数据的（文化）模型在深度学习系统外部，但是从另一个角度，整个设备和操作必须至少被看作相互连接和共同组成的，但更有可能是人类符号学与机械认知的动态复合（图灵测试或过滤器在这里也不起作用。）贯穿物质城市的大大小小的基础设施总是一个生控体系统认知集合；它们利用了世界的模型，这些模型被编码成一个序列，即使它们被从另一个序列中除去。模特是变化的，不可靠的，甚至对自己来说通常是不能理解的。也就是说，即使深度学习的美妙之处在于它们的超归纳过程如何产生与我们自己的思考模式不（或不能）匹配的结果，对于期望输出的相关输入数据的“外部”组合已经内化为它的操作。正如预期的那样，前面也已经表明，训练数据中的显性和隐性偏差（“什么是风险？谁的面貌风险更高？”）不仅反映在输出中，而且被合成和放大，并且经常被假性的客观面貌所遮蔽[16]。

在该领域

无论这件衣服终会是座城市废墟，还是新的野蛮理性，都无关乎预测，重点是它是如何构成的问题。尽管人工智能城市化是一种映像，但它也是一种背离，如果过于关注前者，就会预先防范后者，那将是一个可怕的错误。或者，更确切地说，我们不应该只在映像中看到自己。我们不仅可以通过在表面引入信息媒体来描述无处不在的计算，还可以通过它如何利用和操纵已经存在的信息来描述。在理论和实践中，它的普遍性可能会深入到物质的基体，并跨越不规则的距离。早在现代计算机技术，甚至是类人生物出现之前，进化就已经从最初的熵转向了生化异质性和嵌套多样性。“信

16　参阅艾琳 • 卡里斯坎（Aylin Caliskan），乔安娜 •j• 布莱森（Joanna J. Bryson），阿文 • 纳拉亚南（Arvind Narayanan）“语料库自动衍生的语义学包含了类人的偏见（Semantics derived automatically from language corpora contain human-like biases）”《科学》第 356 期（2017 年 4 月 14 日）：183-186 页。以及安东尼 •G• 格林沃尔德（Anthony G. Greenwald），“人工智能刻板印象捕捉器（An AI stereotype catcher）”《科　学》第 356 期（2017 年 4 月 14 日）：133-134 页。

息”被理解为世界秩序的演算，正如从遗传编码和传播模式，生物体形态，横向污染和共生，种内性选择，物种间生态位动力学，显示和伪装，以及各种跨界移动的信号所见一样[17]。从这个意义上说，信息与其说是消息本身，不如说是在给定环境中实现调解的可能性空间的度量。

现在，当我们凝视着第六次大灭绝的悬崖面时，信息也是衡量这种多样性崩溃的尺度。烃类（碳氢化合物）提取的疯狂循环，瞬时构成快速有序的形式（可塑的这样，或可塑的那样），以及将这些转化为无法足够快速代谢再吸收的废物流，在许多其他事情中，是一个信息图形（及损毁）[18]。也就是说，任何我们希望保护生态经济最大信息多样性的道德规范都将受标准化的功能作用限制，该作用让意义编码本身成为交流。举例来说，碳原子循环如何意味着尽管有机生命衰亡，它也会以不同的方式重新生存，或分泌酶中的共同特征如何意味着蚁群内雌雄异体的交流会维系它的组织，或光谱中共享的视觉范围如何使伪装变得可能，以及发送者和接收者之间的共同符号参照如何使任何复杂的象征经济开始运转，等等。设计必须包括有意引入转化和整合的渠道，以及加强现有差异甚至造成新差异的监管边界。换言之，以生态信息伦理学为指导的设计哲学不能将去领域化提升到领域化之上，反之亦然。

正是由于这一严重的警告，我们将扩充环境的登记纳入人工智能城市化项目。这些由形式生物符号学所描述的过程——寄生物与宿主、开花植物与昆虫、捕食者和被捕食者等之间的关系——不仅是人工智能可能了解的事情，它们也可能直接配备合成传感技术及算法推理技术。“在世界上所有信息丰富的实体中，人脑应当是人工智能假体将延伸的主要甚至唯一的位置，”这一推测是基于对智能是什么和它至底在哪里的多重误解。在这种情况下，智能不仅从我们向世界辐射，它已经存在于世界中，而且在信息形式的定义中（信息*就是*形式）它就是世界。

环境监管及感知系统可以描述并能够预测生命系统状态，但通常不能对其做出反应。它们善于感应而钝于回应。作为一个暂时性的结论，关于这些能够增强生物表皮和促进整个有机体互动的科技，我主张它们应该进一步深入到生态的不和谐状态中。是的：不仅有来自植物的训练数据，而且有给乌鸦的增强现实，以及昆虫的人工智能。这绝非命令和控制，改变不同物种在他们的世界感知、索引、计算及行动的方式可能带来混沌结果（如果有人担心仅仅通过改变稻米使其富含维生素A所产生的连锁效应，我们可以假设会对在TensorFlow（一种软件框架）上兼容的蚂蚁、树和章鱼进行向后倒推）。我勾勒的这一画面与其说是人工智能在其中监管这些生

17　毫无疑问，在某种程度上，描述宇宙和宇宙中万物的信息的“本体膨胀”是由于我们当代技术向我们展示世界的方式，但或多或少与其他任何技术一样。

18　麦肯齐·沃克（McKenzie Wark）在《分子的红：人类纪理论（Molecular Red: Theory for the Anthropocene）》中讨论了这个“代谢裂谷”。Verso出版社，2015年印刷。

物的画面，不如说是一副它们代表自己，并以自己难以理解的方式，沟通和驾驭各种形式的人工智能的画面。我们应该想知道接下来会发生什么。如果控制论的循环被人类自己的使命所垄断，那么合成生物学作为人工智能的一种类型，人工智能作为无机化学的一种类型的见解就没有什么意义了。城市也会穿戴我们。

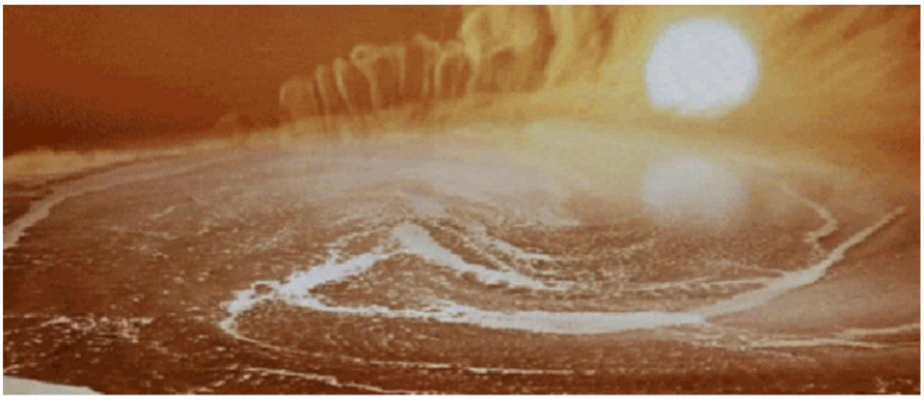
作者简介：

本杰明・布拉顿(Benjamin Bratton)是加州大学圣地亚哥分校(University of California, San Diego)视觉艺术教授、加州大学圣地亚哥分校(University of California, San Diego)设计与地缘政治中心(Center for Design and Geopolitics)的主任，也是瑞士萨斯菲(SaasFee)欧洲研究生学院的数字设计教授。

The City Wears Us. Notes on the Scope of Distributed Sensing and Sensation

Benjamin Bratton

Designers are cutting their marks on what will seem like an insane sentient garment, one which lives on and in the surfaces of our future ruins. This clothing combines different kinds of artificial intelligence, embedded industrial sensors, very noisy data, tens of millions of metal and cement machines in motion or at rest, billions of handheld glass-slab computers, billions more sapient hominids, and a tangle of interweaving model abstractions of inputs gleaned from the above. A furtive orchestra of automation is amalgamated from this uneven landscape and capable of unexpected creativity and cruelty: an inside-out cave we may call, after Stanislaw Lem's ocean of *Solaris*, *the plasmic city*. (The "Smart City" is a different prospect. It employs similar tools, but dreams of municipal omniscience and utility optimization. Within this new garment, modern urban programs that have been drawn by the cycles of residence, work, entertainment of earlier eras are re-sorted, but for the Smart City, they are reified and reinforced, misrecognized as controls when they are actually variables.)



An interstellar ocean of subconscious fear-exploiting goo
in Solaris by Andreï Tarkovski, 1972

I would like to consider the wearability of this garment as a kind of skin. Given that so much urban-scale machine sensing extends or allegorizes vision, it may seem odd to focus on the skin, but it is our largest sensory organ. We have extended synthetic vision and synthetic audition, but modern media has done less to augment epidermal sensation (though much more of late).[1] Still, technologies of skin are part of what humans are. Instead of evolving new skins as we migrated, we honed techniques to make special purpose temporary skins, suited for heat, cold, underwater, ritual dramas, camouflage, or to signal roles, etc. The presentation of

1. See Benjamin H. Bratton. "The Matter of/with Skin." Volume #46: Shelter (December 2015). Print.

self and the sexual selection dynamics that ensue, rely heavily on the local semiotics of how we interpret these artificial skins, and so, we have a global fashion and textile merchandising industry. On a more functional level, synthetic skins modulate our environments, tuning them toward the well-tempered.[2] But it is not just us. Urban sensing lets the surfaces of the city sense its environment as well (who, what, where, when, how?). In turn, urban scale Artificial Intelligence depends less on "AI in a Petri dish" than AI in the wild, feeling and reacting to and indexing its world.[3] As a different and more literal connotation of "distributed cognition" takes form in this way, the already contested line between world-sensing and information-processing gets blurrier.

Tracing what is a prosthesis of whom is open to more perspectives than master-control chains of command.[4] As we wear our skins on our bodies and as our buildings, held under an atmospheric skin in waves of foam (as Sloterdijk would have it), that naturalized arrangement is disturbed by how urban sensing seems to approach proto-sentience. A person is not only a Virtruvian actor at some phenonomenological core who wears the city; he or she is worn as well. We are also the skin of what we wear. The garment being cut and sewn is not only for us to wear; *the city also wears us*.

Urban Sensing and Sensibility

I mean to be descriptive, not predictive, so before considering any sensing and sensation to come, we map the sensing we have. What is most easily called artificial intelligence is based not on an accumulation of raw inputs but on patterned impressions drawn from that data, but any functional intelligence is defined by its ability to act upon its world, and its ability to act is construed by what and how it can sense that world and itself within it. There is a particular and perhaps peculiar affect theory for machines to be unwound over the coming years.

For example, driverless cars are emblematic of big heavy machines sensing/learning in the streets. Their proprioceptive sensors include wheel speed sensors, altimeters, gyroscopes, tachymeters, touch sensors, while their exteroceptive sensors include multiple visual light cameras, LiDAR range finding, short- and long-range RADAR, ultrasonic sensors on the wheels, global positioning satellite systems/geolocation aerials, etc. Several systems overlap between sensing and interpretation, such as road sign and feature detection and interpretation algorithms, model maps of upcoming roads, and inter-car interaction behavior algorithms. Along the gradient from fully to partially autonomous, the humans inside provide another intelligent component that may be variously copilot or cargo, and together they form a

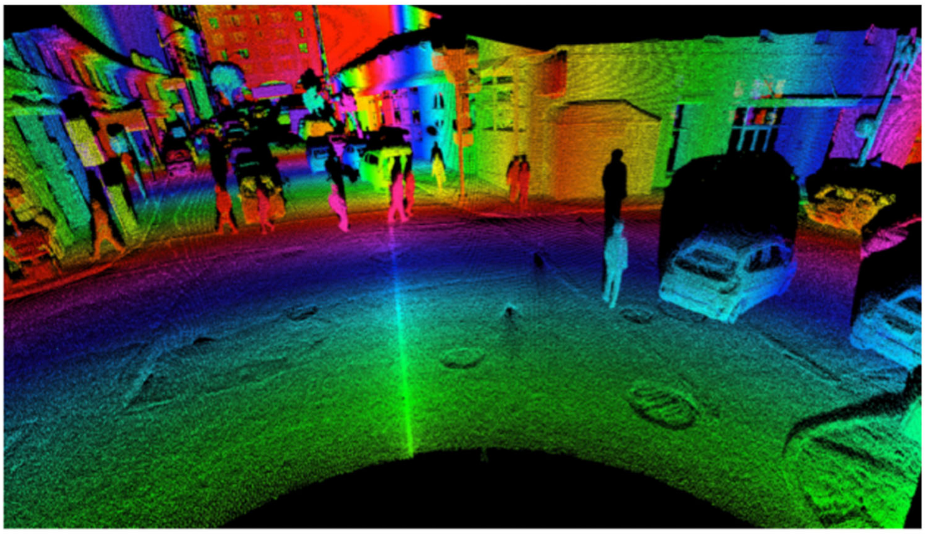
2. The reference is to Reyner Banham. The Architecture of the Well-Tempered Environment (1969). Elsevier, 2013. Print.

3. See Benjamin H. Bratton. "Geographies of Sensitive Matter: On Arti cial Intelligence at Urban Scale." New Geographies. Cambridge, MA: Harvard Graduate School of Design, 2017 (forthcoming). Print.

4. See Jussi Parrika. "The Sensed Smog: Smart Ubiquitous Cities and the Sensorial Body." The Fibreculture Journal 219 (2017). Web.

composite User ambling through the City layer of The Stack.[5]

But the sensing and thinking systems are located not just in the valuable subjects and objects rolling around, they are built into the fabric of the city in various mosaics. Because how a sentient city thinks is inextricable from how a sentient city senses, a good catalog is less a litany of objects in a flat ontology, or the feature set in a new model technology, than an anatomical index of the interlocking capacities and limitations of an incipient machinic sensate world. The distributed body includes not only automotive sensors, but also digital component sensors, flow sensors, humidity sensors, position sensors, rate and inertial sensors, temperature sensors, relative motion sensors, visible light sensors and recording "cameras," position sensors, local area and wide area scanners, vibration sensors, force sensors, torque sensors, water and moisture sensors, piezo film sensors, fluid property sensors, ultrasonic sensors, pressure sensors, liquid level sensors, and so on. From a more panoramic vantage, remote sensing systems in low Earth orbit interlace with terrestrial networks to draw data up and down in turn. Remote geosensing may observe bodies of water, vegetation, human settlements, soils, minerals, and geomorphology with techniques including photogrammetry, multispectral systems, electromagnetic radiation, aerial photography, multispectral systems, thermal infrared sensing, active and passive microwave sensing, and LiDAR at different scales, etc.[6] While many of these have been part of cities, factories and geographies for decades, their integration into the landscape by standardized computational protocols and networks (by conventional Internet of Things models, or otherwise) means that domain specific and more general artificial intelligence has a path out of the laboratory and toward metropolitan-scale evolutionary robotics. How are they to be worn?



Lidar vision from Toyota self-driving car using Luminar technology, 2017.

5. Composite User is a term from my book The Stack: On Software and Sovereignty. Cambridge, MA: MIT Press, 2016. Print. The User is a layer of the Stack model and also a position of agency within that system that may be occupied by any human or non-human actor capable of interacting with the Interface layer. A composite User is comprised of several entities at once that interact with the system as if a single entity.

6. The standby textbook book on these techniques has been John R. Jensen. Remote Sensing of the Environment: An Earth Resource Perspective. Pearson, 2006. Print. Jennifer Gabrys provides an alternative model in Program Earth: Environmental Sensing Technology and the Making of a Computational Planet. Minneapolis: University of Minnesota Press, 2016. Print.

Wearability

Wearable computing, as a domain of consumer electronics, is embryonic at best. Today the term refers to smart watches and sensors that monitor heartbeat or glucose level in sweat, or blinking lights on clothes triggered by sequencing software. Not very inspiring stuff so far. In time, however, as microelectronics and signal processing layers shrink and become more energy efficient, the expanded sector of "wearables" may become predominate, just as mobile computing took leave of desktop computing. Of more interest to us is how the miniaturization and flattening of system profiles may allow them to cover many different kinds of skins: animal and vegetal skins, architectural skins, machine skins, etc. Any surface is potentially also a skin and its sensitivity is open to design. The sensor arrays that outfit those drivers' cars, for example, will evolve, combine and specialize further. Descendants of these arrays may cover other machines, in motion or at rest, familiar or unfamiliar. Wearability then is not just for human users, or even only bodies in motion, but for any "user" that has a surface.

Just as what counts as a skin changes once the sensory capacities of a surface are made more animate, what counts as "wearability" changes as diverse skins are augmented by *shared* sensors. That is, the flexibility and ubiquity of these sensors is also a function of the *platformization* of components and sub-components across applications, and the distribution of the same or similar sensors across unlike surfaces means that very different kinds of bodies share the same sensory systems. A version of a sensor stuck onto a mammal skin may be derived genealogically from one on an assembly-line, and if we take seriously the implications of technical evolution, then this blurring and blending of sensors across different dermal surfaces stitches cyborgs together as much as the inter-assembly of organs.

However, today's recommended uses of wearables are trained on banal key performance indicators and the optimization of functions that may have been derived from waning social contexts. The potential of wearable computation considered widely is not this auto-managerialism, but the flowering of unforeseeable biosemiosis between users now capable of sensing and being sensed by one another in strange ways. These may be one-off experiences, which remain isolated and unthought fragments, or they may cohere into more profound processes around which we decide who we are.

In the meantime, our conventional understanding of our own skin will drive and curtail what the expanded scope synthetic skins/wearable computing is asked to do. But sooner rather than later we may encounter phenomena for which we do not have sufficient words (just as we have such an incomplete language for pain, the glossary of touch is mute) and the skin we live in now will be made new again by new terms.

To Be Clothed

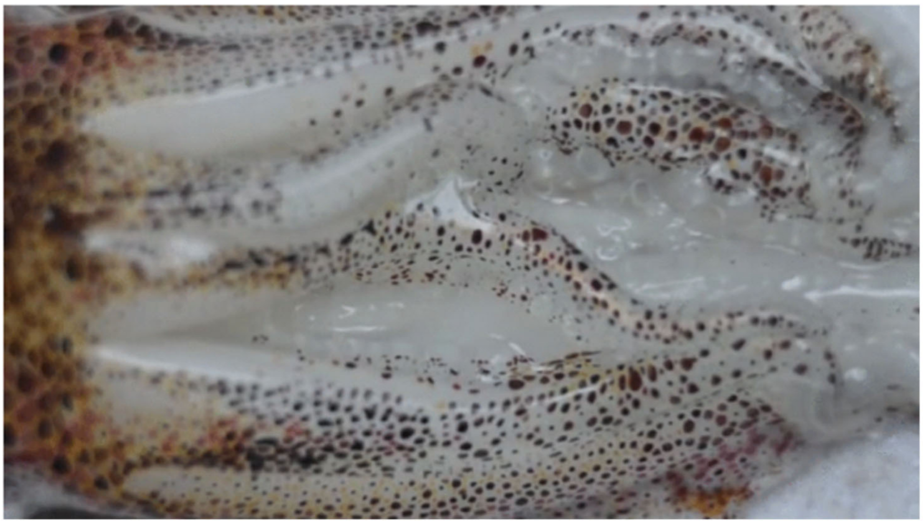
Clothing is already a synthetic skin, and its functions are not only thermal regulation or protection against abrasion, but to communicate to other people significant subcultural information about *who* we are, not only what we are. It is not simply that red clothes will mean one thing and blue another, but through its incredibly nuanced semantics, fashion produces temporary phenotypes that signal to one another within the twists and turns of hypercontextual references: the seasonal formality of the hem, the size of a collar, the drabness of a green, the obtuseness of a brand/band on a t-shirt, and the volumetric ratio of spheres that comprise a necklace that may or may not also connect to a triangular fold that exposes only so much of a shoulder. Social dynamics are not only represented or *performed* by this plastic semiotics, they are directly and immanently calculated by them.[7]

We are not by far the only animal to do these sorts of things, and different paths draw in other forms of distributed cognition.[8] While we developed synthetic skins, other animals evolved more complex natural skins capable of incredible feats of signification. Cuttlefish, for example, use chromatophores in their skin to dazzle prey, to hide from predators, and to communicate with other cuttlefish. The same reaction may serve different ends depending on the context of presentation. (While crows do seem to have a practical theory of mind, we do not presume that cuttlefish are able to imagine what their skin my look like to another organism, and so to call their shimmering "performance" is probably inaccurate. If so, what then do they see in and as one another?) Importantly, the intelligence is *in* the skin itself. Cuttlefish's chromatophores and iridophores instantaneously modulate to produce dazzlingly complex patterns that correspond to isomorphic neuronal patterns. As skin and brain are bound up into direct circuits, we may say that the membrane's incredible animations are as much a nervous reaction as a cognitive one. The lesson from cuttlefish for how we should imagine a rich ecology of urban-scale AI is profound. It not the aloof central processing brain of Godard's *Alphaville*; it is something far more distributed and far less Cartesian. The intelligence is in the skin and the urban sensing regime on whose behalf we design, may be something like a topography of post-cuttlefish drawn from a Lucy McRae project.[9] But beyond hyperstitional provocation, what about the nuts and bolts engineering of sensing and sensation? At what scale does it start?

7. The boundary semantics of these is explored by designers such as Rei Kawakubo, Hussein Chalahayn, Iris van Herpen, and many others. Situating fashion as an antecedent form of populist synthetic biology, Lucy McRae puts in play the predation and display (o ensive/defensive, aggression/seduction) between singular organisms and leaves them undecided. While these may gesture to biotechnological gures of self, and only secondarily to species, elsewhere an aesthetics of standardization (Laibach, Wal-Mart, all black wardrobes) describe a mutable mass body.

8. See for example, Elizabeth Grosz. Chaos, Territory, Art: The Framing of the Earth. New York: Columbia University Press, 2008. Hanna Rose Shell. Hide and Seek: Camou age, Photography, and the Media of Reconnaissance. Cambridge, MA: Zone Books, 2012. Print.

9. For more of McRae's work see https://www.lucymcrae.net



Squid camou aging patterns (chromatophore).

Everything is a Chemical

All economics is ecological economics. It should go without saying that design does not float as some virtual layer on top of a given nature. Some design philosophies understood this long ago, and the history of post-Asilomar biotechnology is adorned with conjectural biodesign concepts, narratives and diegetic models, and these inform debates by which the ethical, ecological and political implications of these technologies are considered.[10] Biotechnologies are controversial along regular political fault lines, and yet across these, concerns are sometimes possessed by afterimages of creationism. By that term I do not (necessarily) mean the belief that everything in the world was created by a monotheistic agent. It is rather a more diffuse sense that the order of the world is not only a dynamic adaptive system, but a special *text* in which instantiations of metaphysical essences appear to us. Furthermore, it believes that this order is best served by not contaminating those forms (the theologically inspired taboo on scientific agriculture evangelized by, for example, Vandana Shiva) or denying that fundamental perturbations of the system are really even possible (the theologically inspired denial of anthropogenic climate change evangelized by, for example, Sen. James Inhofe).[11] These are often accompanied by admonitions against humanity’s hubris and overreach. I see it quite differently. Instead what is at stake for biodesign has less to do with control (real or imagined) over nature, and whether that is good or bad, than with demystifying the royal human body back into material churn, and locating the designing subject as *a form of matter that is acting on matter that it inhabits*. In this mode, the limiting foundation of design is *chemical*.

How so, and how to? Consider the Nanome project that we helped develop at D:GP at University of California, San Diego. It is a set of VR-based scientific modeling and design tools, including CalcFlow

10. The 1975 Asilomar Conference on Recombinant DNA set guidelines for scienti c experiments in the use of recombinant DNA and provided a precautionary framework for such research since. It is seen as an important event in the public awareness and debate about the safety and propriety of advanced biodesign. More recently, similar summits have attempted to frame the development of CRISPR/Cas9 gene editing techniques, with varying and uncertain degrees of success.

11. Timothy Morton, will go so far as to claim that causality and aesthetics are the same thing. See his Realist Magic: Objects, Ontology, Causality. Ann Arbor: University of Michigan, 2013. Print. Arguably, this conversation is retarded by the in ation and scope creep of literary or art criticism into the humanities at large. As Peter Wolfendale puts it, “Everything is treated as a symbol, and symbolic connections are freely substituted for causal ones.” Exemplifying how this leads to a confusion of the world with preferred “readings” of the world is TJ Demos. See for example how his assignment as art critic leads him to outlandish recommendations about the politics and programs of biotechnology, ecological economics, agricultural policy, and food supply infrastructures understood as “pieces” to which we may “respond.” See his talk, “Gardens Beyond Eden Bio aesthetics Eco futurism and Dystopia at dOCUMENTA (13).” 18 June 2013. The White Building. Web. https://www.youtube.com/watch?v=TCnF1NQxT-Fw&t=2893s in which he draws an appropriately sharp distinction between the work of the aforementioned Shiva and Donna Haraway, but from there heads o on typically solipsistic cul-de-sacs.

and NanoOne.[12] In short, you use virtual math to make virtual physics, which you use to make virtual chemistry, which you use to make virtual biology. Applications for biotech, and drug discovery are the first trial applications, but providing easier ways to visualize math as a building block of molecular modeling has more fundamental implications.[13] As with many other complex design softwares, we see the integration of machine learning systems to augment and extend form-finding gestures, and in this case we see the accumulation of design queries and solutions also used as training data for biotech research AIs.[14] That is, the *interface* layer for the human user (a means to map, model and simulate material processes) is the input layer for the AI (a pattern of inquiries, both inductive and deductive, that structure the search space for the machine learning system). In this sense, synthetic biology may be seen as a *genre* of applied artificial intelligence. Together these may support important breakthroughs (some day: industrial scale synthetic photosynthesis and individual genome-tailored drug therapies on demand, etc.) and make the "culinary materialism" of biochemistry more available to popular design/hacker initiatives (hopefully a good thing).[15] In fact, the former may prove only to be possible because of the latter.

We think we know quite a bit about animal intelligence and plant intelligence, but AI at urban scale is for the most part a mineral intelligence. Metals, silica, plastics and information carved into them by electromagnetism form the material basis (but not entirely, as I will consider below). In turn, artificial intelligence is a genre of applied inorganic chemistry. Emphasizing the sensory inputs that locate any AI in its own kind of world, we see that this mineral footing does not withdraw it into some arid vacuum from the wet, hot, thermodynamic flesh of the world, quite the contrary. If as Russian Cosmist Nicolai Fyodorov surmised over a century ago, we are the material folded just so, through which the Earth thinks itself, then such folds are available to different sorts of matter as well, including the mixture of organic and inorganic compounds that comprise urban scale AI sensing/thinking systems.

Solar panels, Neom project, Saudi Arabia, 2017
Excerpt from a promotional video available on discoverneom.com

12. See nanome.ai and SteamVR where working versions of both applications are available for download.

13. Clearly the real complexity of chemistry is far greater than these blocky digital cartoons, but their purpose is functional abstraction. The point of this design tool is not to produce an ontologically accurate double of matter. It is to o er a pen and wrench with which to fashion workable model abstractions as part of laboratory bench work ows.

14. Other companies and projects working at the intersection of AI and biotech research include Atomwise, Mendel.ai, GEA Enyzmes, and A2A Pharma.

15. The term "culinary materialism" is borrowed from Collapse VII: Culinary Materialism. Falmouth: Urbanomic, 2011. Print.

The Persistence of Models

In trying to pinpoint where artificial intelligence can or cannot be located in this folding, defining practical relationships between sensing and thinking come to the fore. Durable threads from Hume and Kant debates enter back: how (and finally *if*) the sensorium of empirical observation relates to a "transcendental" frame that gives moral coherence and wider deduction from what is sensed into reflective judgment, and ultimately phenomenological interiority. For purposes of AI urbanism, we may invoke this foundational division in modern European philosophy provisionally and perhaps only analogically, but at what point must the inorganic chemistry project of engineered sensation possess something like a "frame"? Or, could it congeal or graduate into possessing one, and if it did, how would that shift how we draw such frames in the first place?

Alongside Reza Negarestani's cartographies of inductive and deductive epistemic modalities, we may qualify different species-genres of artificial intelligence according to their relative reliance on either end of this spectrum: input-rich/ model-poor (inductive) input-poor, model-rich (deductive). Broadly we may say that older Good Old-Fashioned AI based on symbolic logic relied on more deductive means through the formal construction of models of a given problem space based on understandings of local and intermediate scales of cause and effect within that space. In principle, if an AI were to encounter a real-world version of that problem space it would deduce what to do next by the application of generic logic to the specific instantiation. For many well-known reasons—from insufficient data and processing resources to adaptive limitations of logical symbolization—these methods have fallen out of favor compared to more inductive approaches. For example, deep learning systems based on artificial neural networks build functional responses to input corpora, limning vectors into recognizable outputs. For such systems, functional response to inputs can be achieved without the system producing anything like a recognizable formal "model" of the problem space.

However, we cannot only look for such frames in AI systems abstracted from real world implementation. But while the opacity of Deep Learning processes does suggest interesting and alien forms of "thought," as practical apparatuses of urban infrastructure our AI systems are not without explicit or implicit human cognitive bias, positive or negative. Drawing on a different connotation of the term, you do need weights and bias in an artificial neural network to find evidence of a particular pattern. But the organization of input data into a useful corpus is itself informed by at least several models, including cultural models, that are necessarily full of apophenic errors and pathologies. By one view of this system, the (cultural) model that would structure input data is *external* to the deep learning system, but for another the *whole* apparatus and operation must be seen as at least interconnected and co-constitutive, but more likely part of a dynamic composite that mixes hominid semiotics with machinic cognition (Turing Test either/or filters do not work here either.) The small and large infrastructures that thread through the plasmic city are always a cyborgian cognitive assemblage; they draw upon models of the world that are encoded into one sequence even as they are subtracted from another. Models are mobile, slippery, usually unaccountable even to themselves. That is, even while the beauty of deep learning is in how their hyperinductive processes yield results that often do not (or cannot) match our own models of how we think that we think, the "external" composition of what is relevant input data for the desired output is already internalized into its operations. As would be expected, and as has been shown, explicit and implicit bias in training data ("What is risk? Whose face is risky?") is not only reflected in outputs but is synthesized and amplified, and often then shielded by veneers of false objectivity.[16]

In the Field

Whether ultimately this garment cloaks urban ruins or a new rationality of wilderness is a matter of composition not prediction. Even as AI urbanism is a reflection, it is also a departure, and it would be a dire mistake to forestall the latter by preoccupation with the former. Or, more precisely, we should not only see ourselves in the reflection. We may describe ubiquitous computing not only by the introduction of information media onto surfaces, but also by how it draws upon and manipulates information that is already there. In theory and practice, its ubiquity may extend deep into the material substrate of things and across irregular distances. Long before modern computing, or even the appearance of humanlike creatures, evolution has drifted away from primordial entropy and toward biochemical heterogeneity and nested diversity. "Information" has been understood as the calculus of that world-ordering, as seen in patterns of genetic encoding and transmission, organism morphologies, transversal contamination and symbiosis, intraspecies sexual selection, interspecies niche dynamics, displays and camouflages, and various sorts of signaling across shifting boundaries.[17] Information, in this sense, may be less the message itself than the measure of the space of possibility by which mediation is possible in a given context.

Now, as we stare down the cliff face of a sixth great extinction, information is also a measure of that collapsing diversity. The mad cycles of hydrocarbon extraction, its instantaneous fabrication into fleetingly-ordered form (a plastic this, or a plastic that), and the transfer of

16. See Aylin Caliskan, Joanna J. Bryson, Arvind Narayanan. "Semantics derived automatically from language corpora contain human-like biases." Science 356 (14 April 2017): 183-186. Print. and Anthony G. Greenwald. "An AI stereotype catcher." Science 356 (14 April 2017): 133-134. Print.

17. It is doubtless that on some level, the "ontological in ation" of information to describe the universe and everything in it is due to the how our contemporary technologies show us the world, but no more or less so than any other such.

these into waste flows that cannot be metabolically reabsorbed quickly enough is, among many other things, an informational figure (and disfigure).[18] That said, any ethics for maximum informational diversity that we would hope to underwrite ecological economies would be qualified by the functional role of standardization that allows encoded signification to become communication. Consider for example how the recycling of carbon atoms means that as organic life decays it also lives again in different form, or how the common signatures within secreted enzymes means that stigmergic communication within an ant colony will sustain its organization, or how a shared range of vision within the light spectrum may make camouflage possible, and how the common semiotic references between sender and receiver sets any culturally complex symbolic economy in motion, and so on. Design must include the deliberate introduction of both channels of translation and integration and as well as regulatory boundaries that enforce existing differences or even cause new ones. In other words, design philosophy informed by an ethics of ecological information cannot elevate deterritorialization above territorialization or vice versa.

It is with that serious caveat that we scope the enrollment of augmented environments into programs of AI urbanism. Processes described by formal biosemiotics—relations between parasites and hosts, flowering plants and insects, predators and prey, etc.—are not only things about which AI may know, they may also be directly outfitted with technologies of synthetic sensing and algorithmic reason. The presumption that of all the information-rich entities in the world the hominid brain should be the primary if not exclusive seat from which prostheses of AI would extend is based in multiple misrecognitions of what and where intelligence is. In such a circumstance, intelligence does not only radiate from us into the world, it already is in the world, and in the form of information (which *is* form) it is the world.

Environmental monitoring and sensing systems can describe and predict the state of living systems over time but usually cannot act back upon them. They are sensor-rich and effector-poor. By way of a provisional conclusion, I advocate that technologies that augment the capacities of exposed surfaces, whole organisms, or relations between them should extend deeply into the ecological cacophony. Yes: not only training data from plants, but augmented reality *for* crows, and artificial intelligence *for* insects. Far from command and control, altering how different species sense, index, calculate and act upon their world may introduce chaotic results (if some people are concerned about the cascading effects of merely modifying rice to make it rich in Vitamin A, we can assume there will also be pushback on TensorFlow-compatible ants, trees, and octopi.) The picture I draw is less one in which the AI supervises those creatures than one in which they themselves inform and pilot diverse forms of AI on their own behalf

18. McKenzie Wark discusses this "metabolic rift" in Molecular Red: Theory for the Anthropocene. Verso Press, 2015. Print.

and in their own inscrutable ways. We should crave to learn what would ensue. The insights of synthetic biology as a genre of AI, and AI as a genre of inorganic chemistry, mean little if the cycles of cybernetics are monopolized by humans' own errands. The city will also wear us.

Benjamin Bratton is Professor of Visual Arts and Director of The Center for Design and Geopolitics at the University of California, San Diego, as well as Professor of Digital Design at The European Graduate School in SaasFee, Switzerland.

城市穿戴着我们
——关于分布式传感和感知范围的说明

The City Wears Us. Notes on the Scope of
Distributed Sensing and Sensation

作者：本杰明・布拉顿 / Benjamin Bratton

翻译：冯雪娇

编辑：陈玺安 / Zian Chen

主编：器道哲学与技术网络 /
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