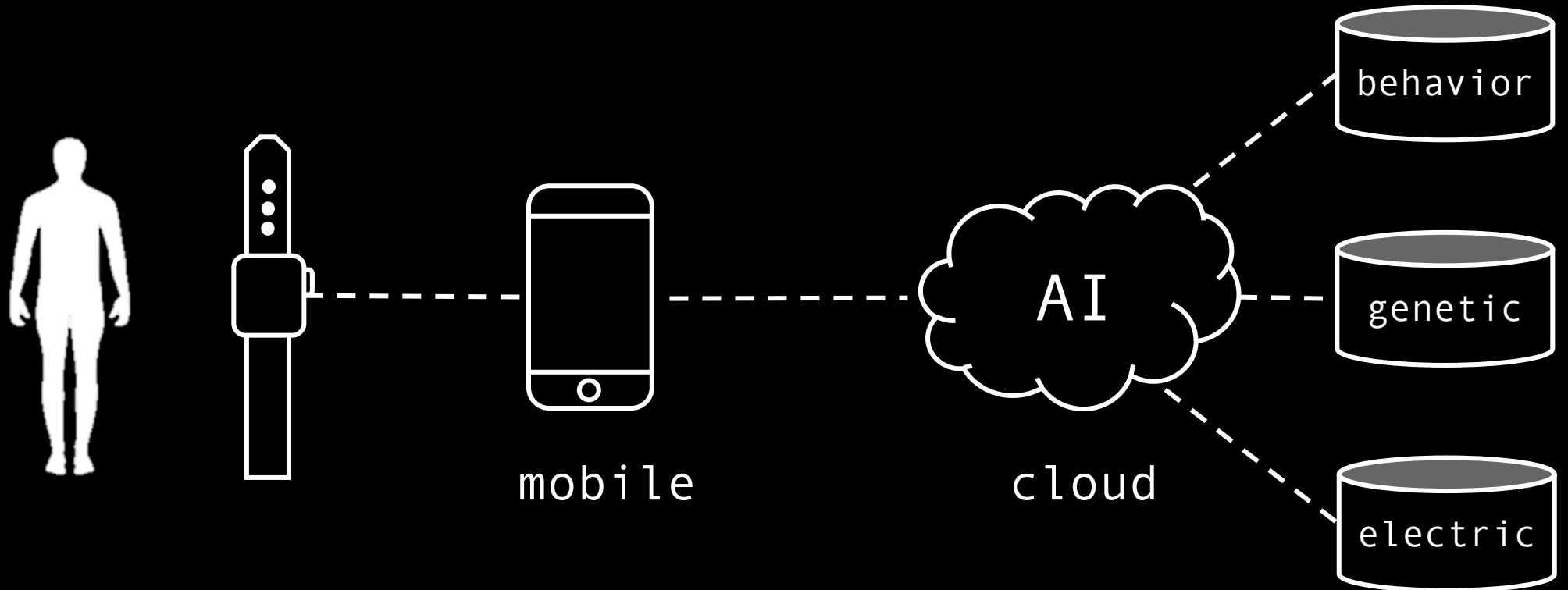# technology trends
from diagnosis to treatment

Jan Madsen, Professor

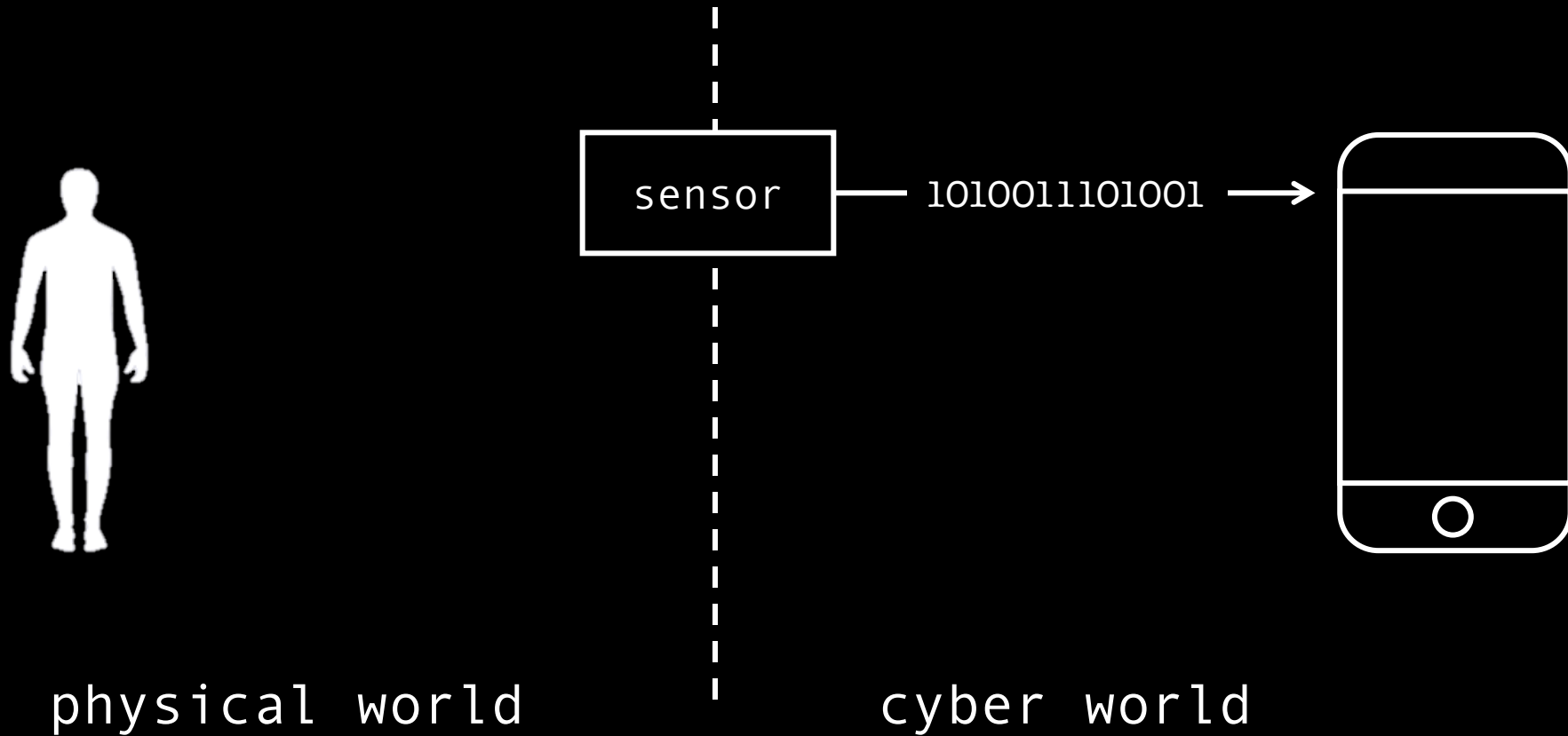DTU Compute

Healthcare Innovation, Nov. 2017

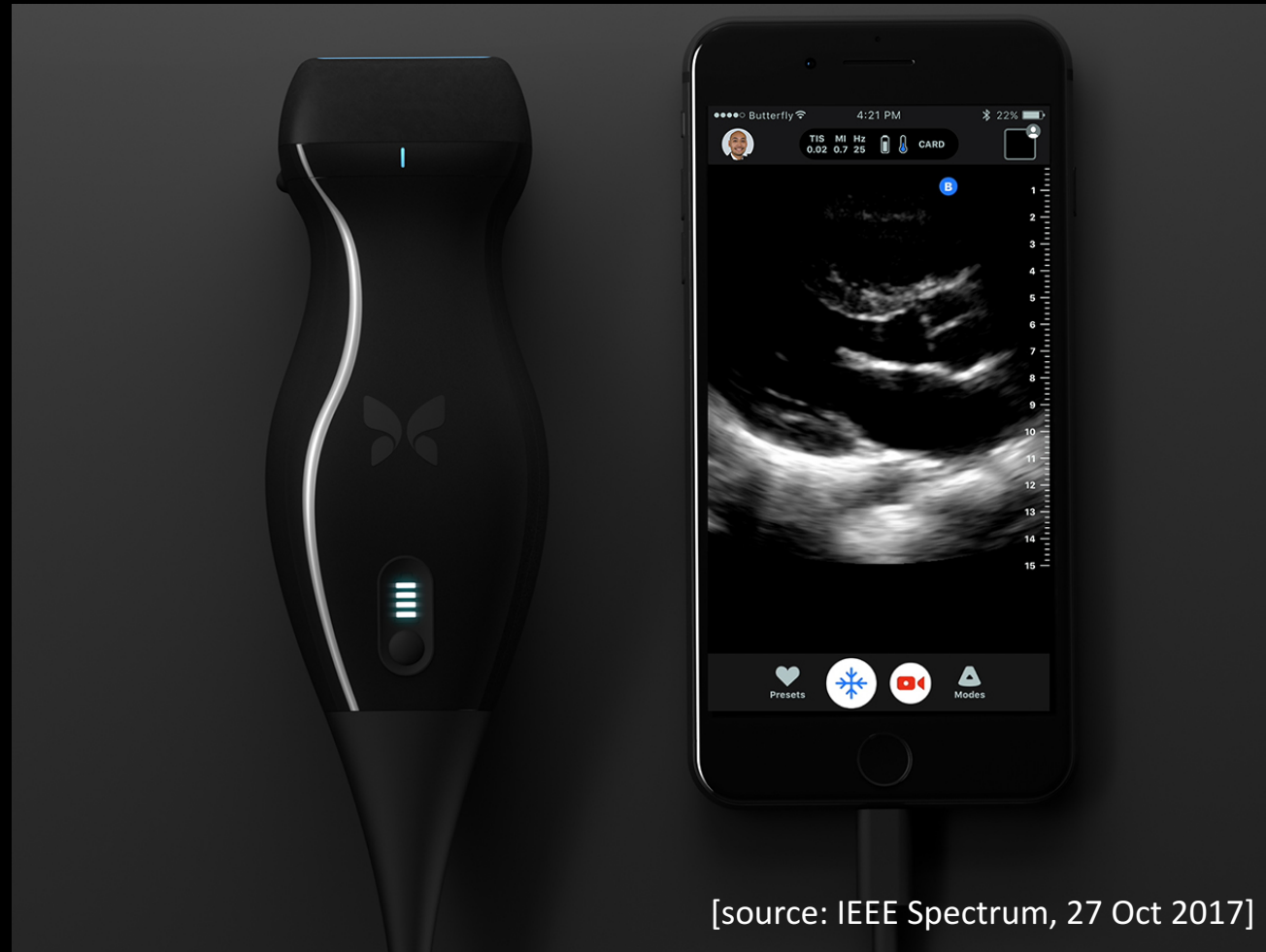$f(x+\Delta x)=\sum_{i=0}^{\infty}\frac{(\Delta x)^i}{i!}f^{(i)}(x)$
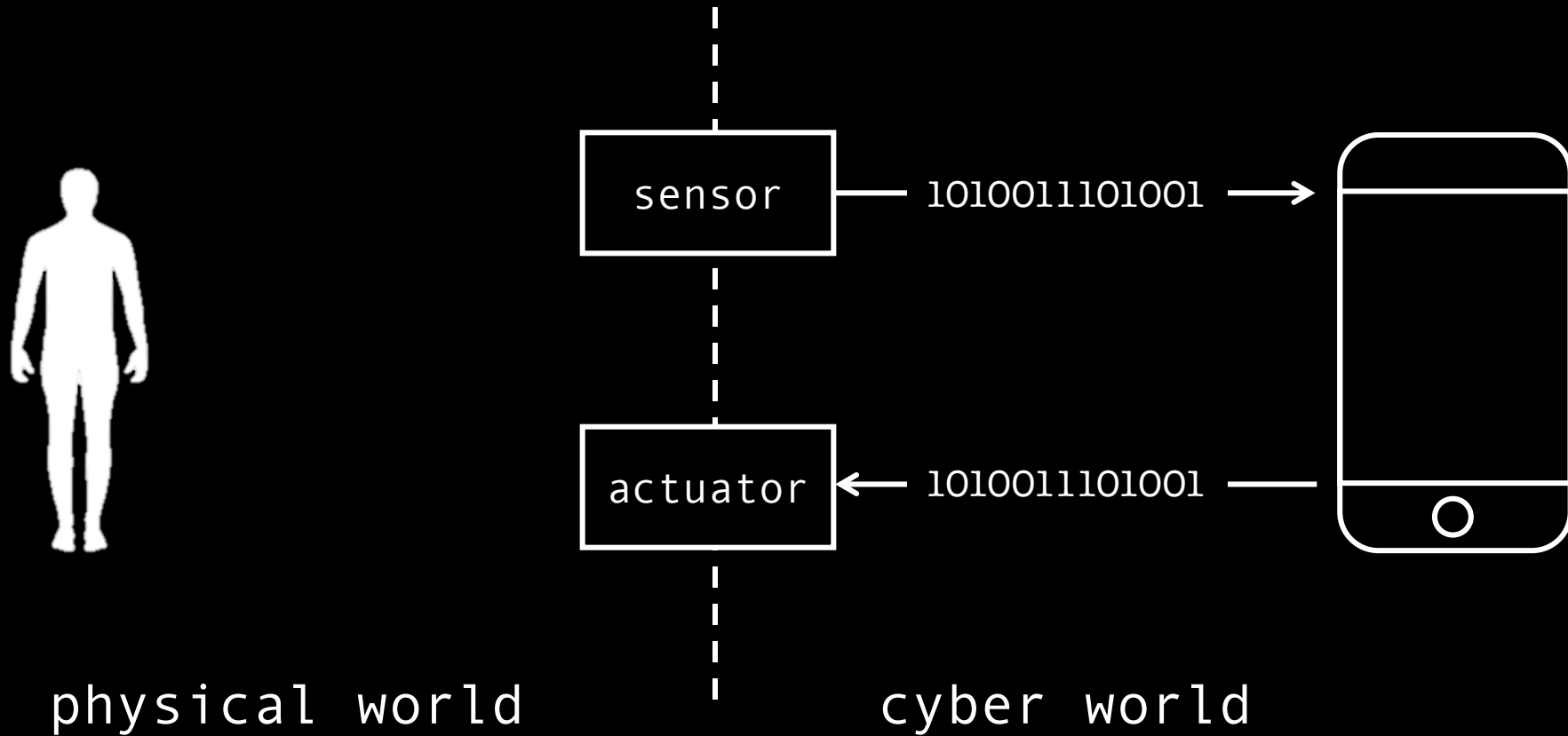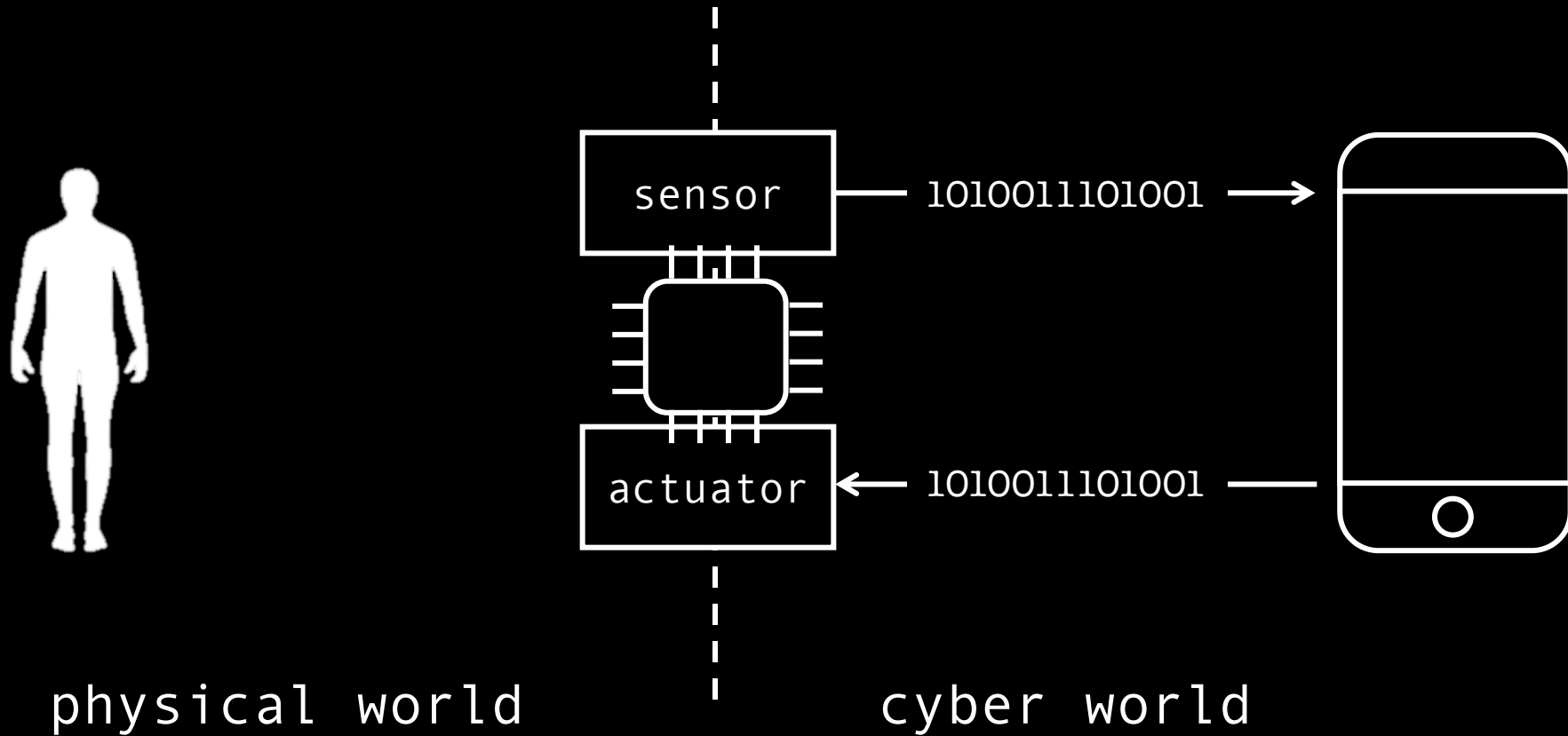
DTU

current practise

mobile   cloud

behavior

genetic

electric

data?

sensor 1010011101001

physical world | cyber world

Ultrasound on-a-Chip

[source: IEEE Spectrum, 27 Oct 2017]

data?

sensor   1010011101001

actuator   1010011101001

physical world | cyber world

data?

sensor

1010011101001

actuator

1010011101001

physical world

cyber world

computer-on-a-chip

50 mm^3

50.000.000 transistors

Intel Atom processor

digital pill

[Proteus Medical]

Patent US 2010/0185055 A1
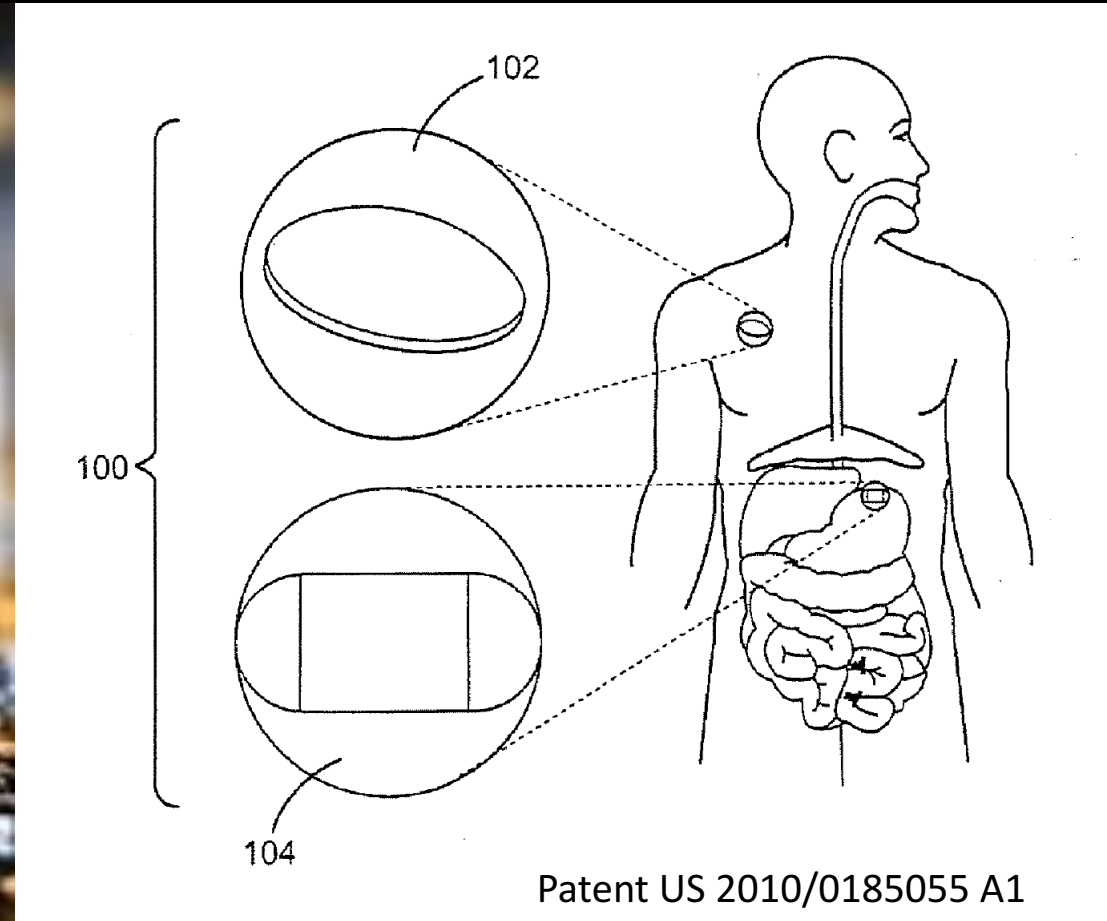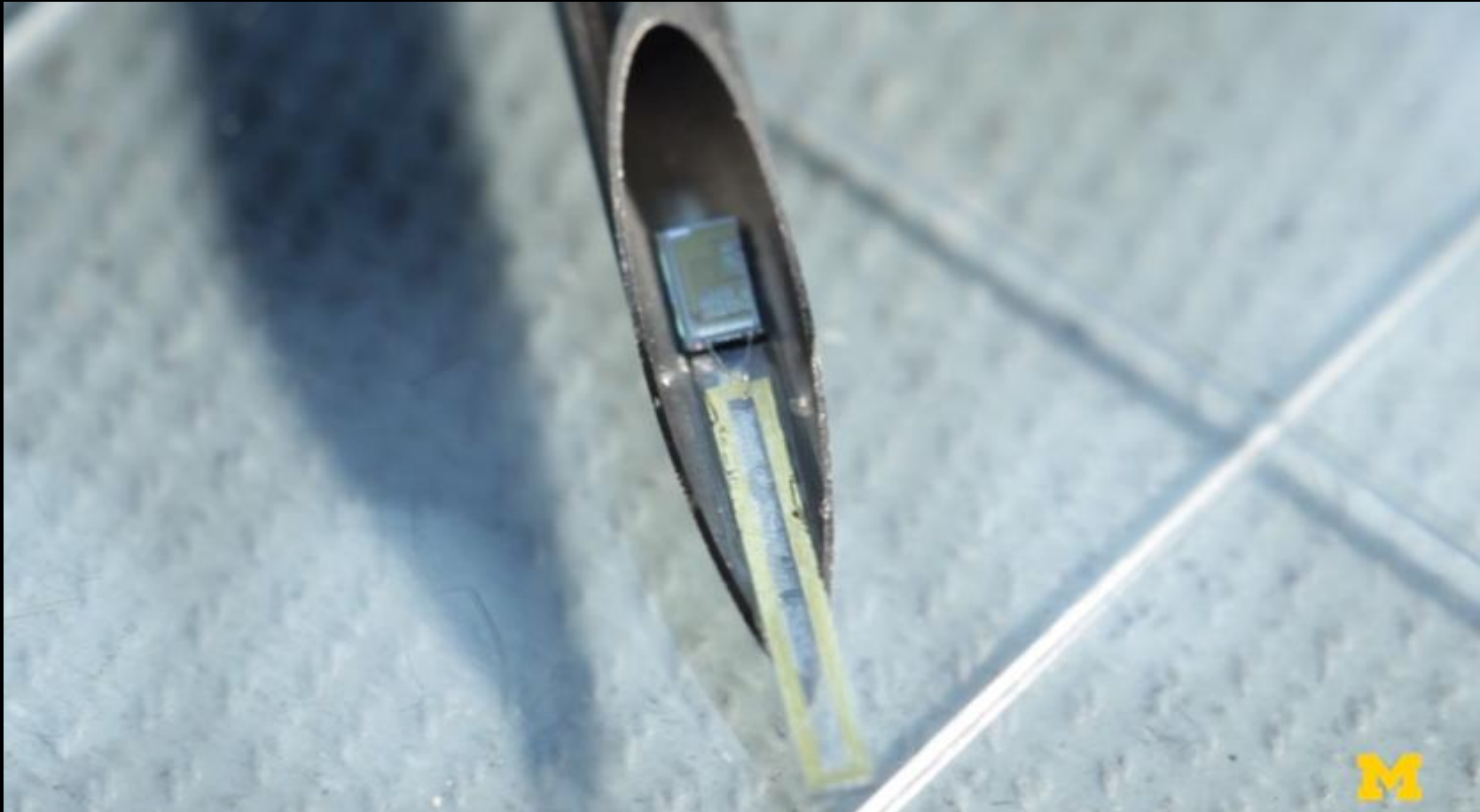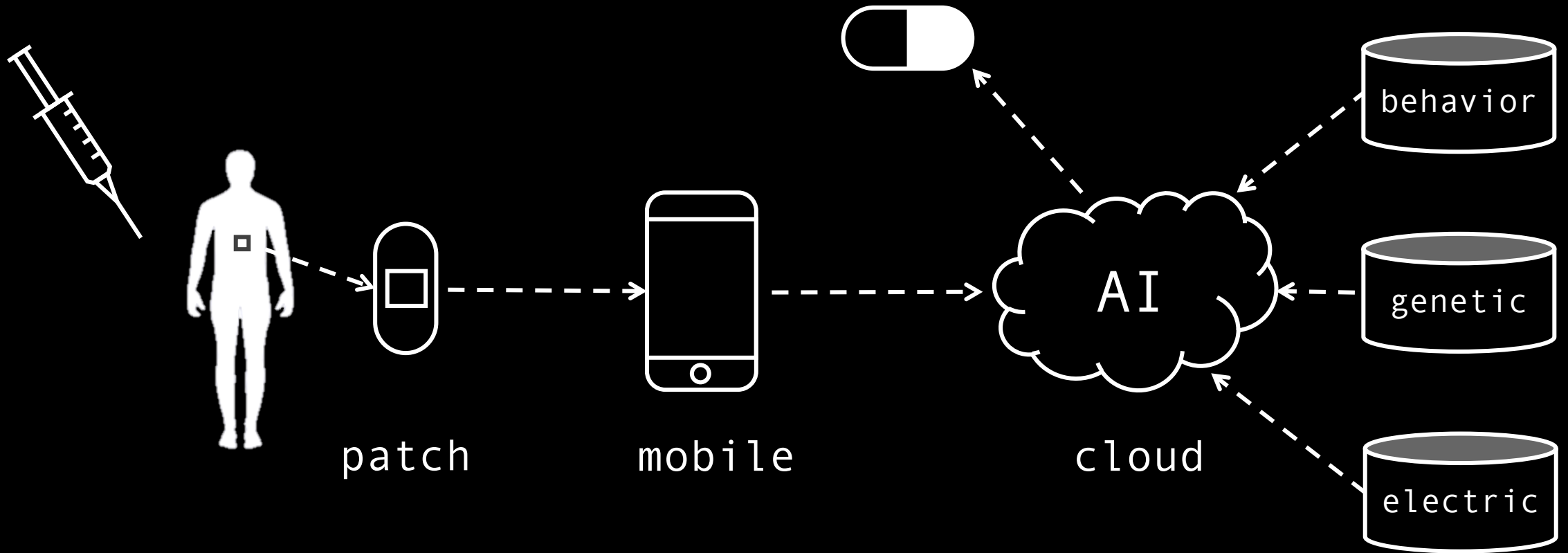
smart dust computer

1 mm^3
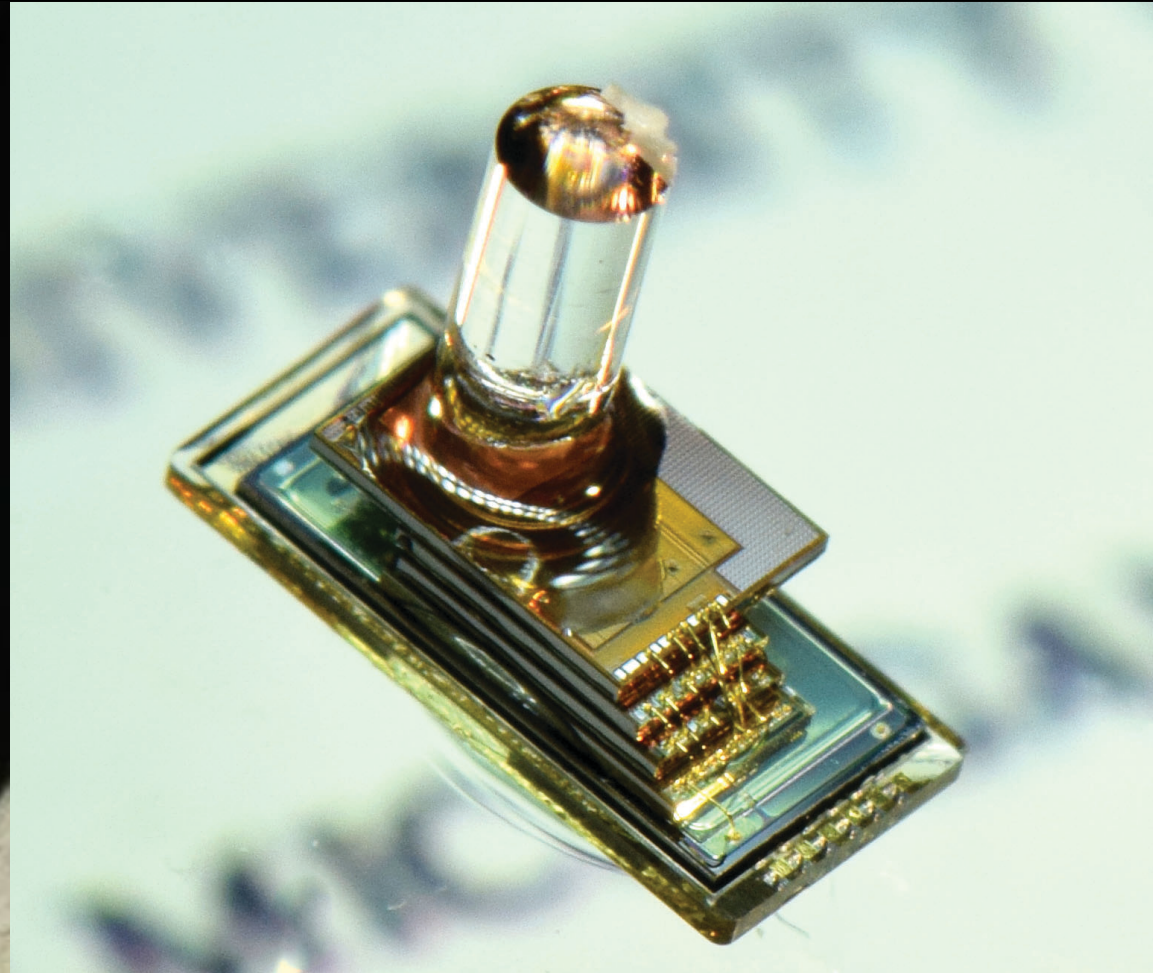
[Michigan Micro Mote, ECE University of Michigan]
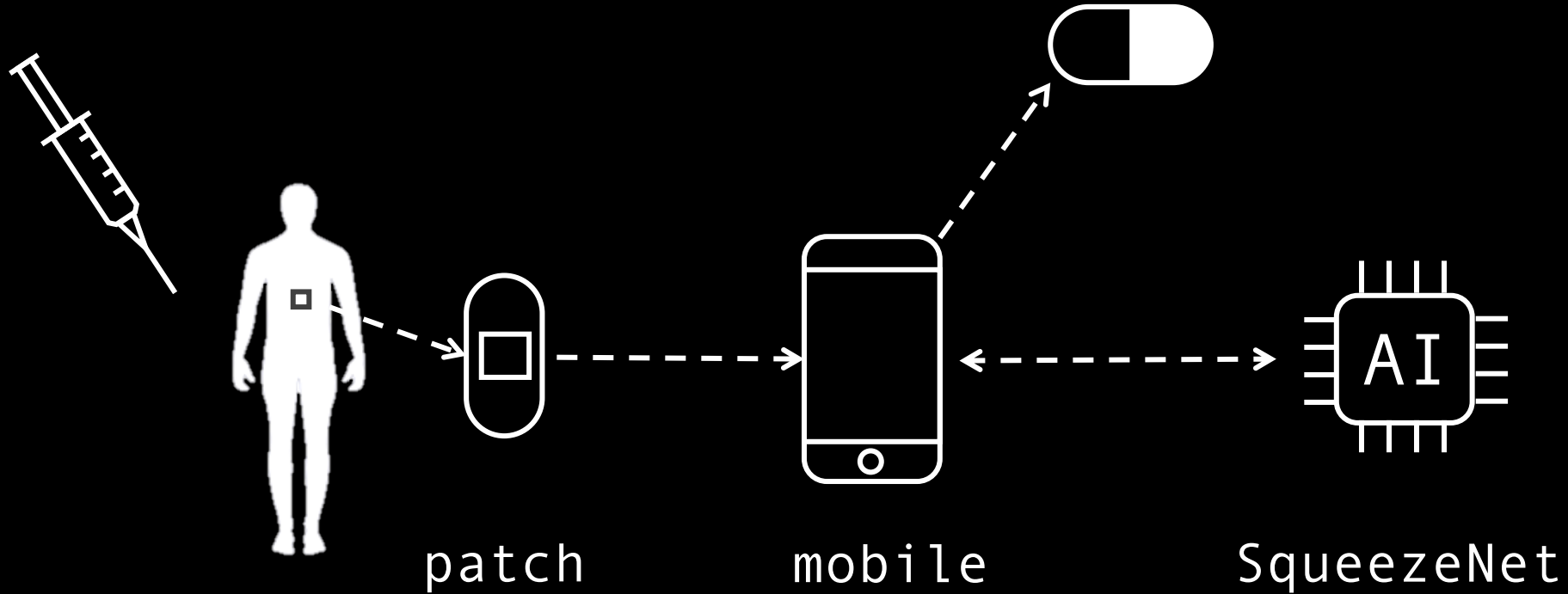
implantable computer

Y. Shi et al. "A 10mm3 Syringe-Implantable Near-Field Radio System on Glass Substrate,"
IEEE International Solid-State Circuits Conference (ISSCC), 2016

from diagnosis to treatment

patch   mobile   cloud

AI

behavior

genetic

electric

AI-on-a-chip

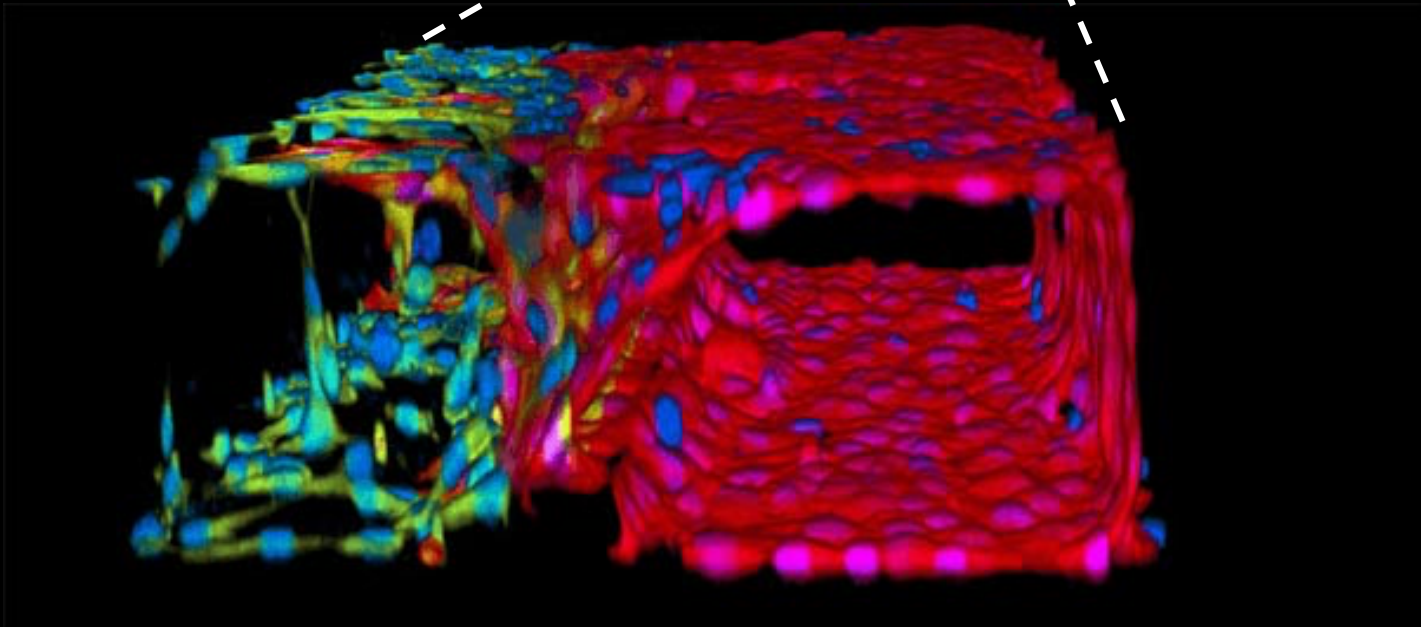patch   mobile   SqueezeNet
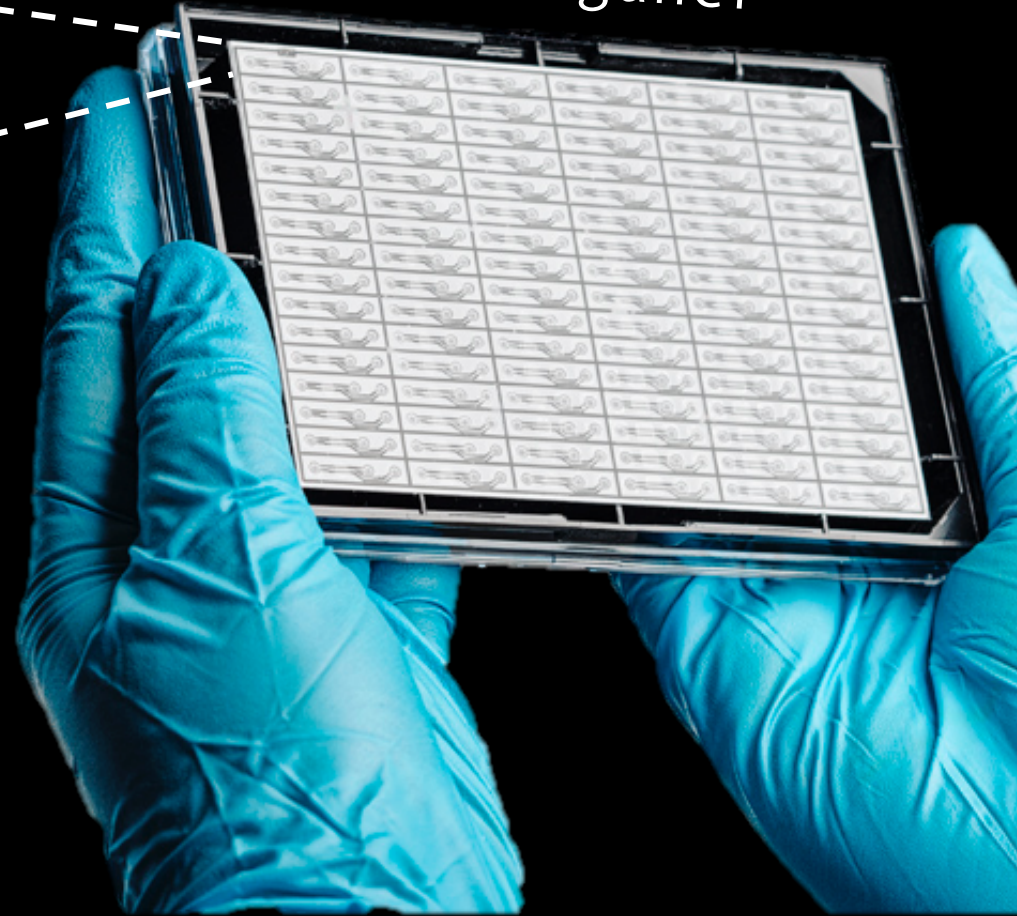
3D printed pill

[World's first approved 3D-printed drug by Aprecia Pharmaceuticals, 2015]
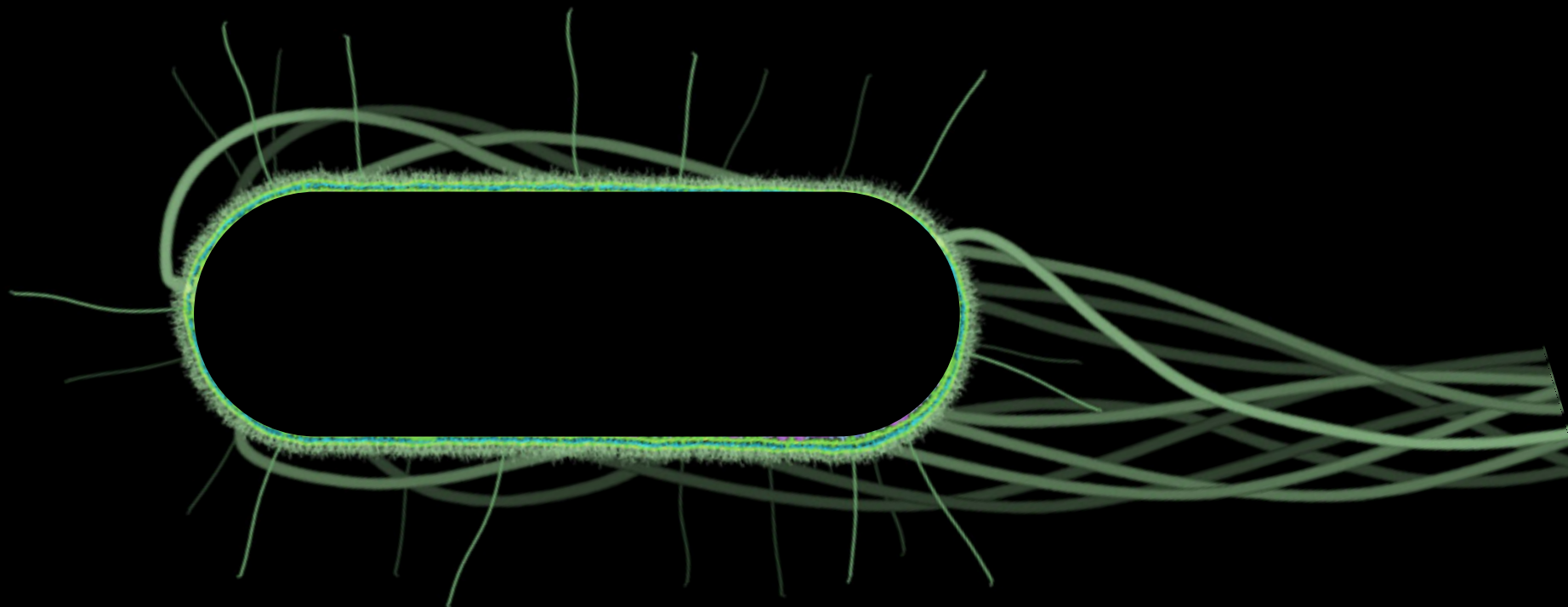
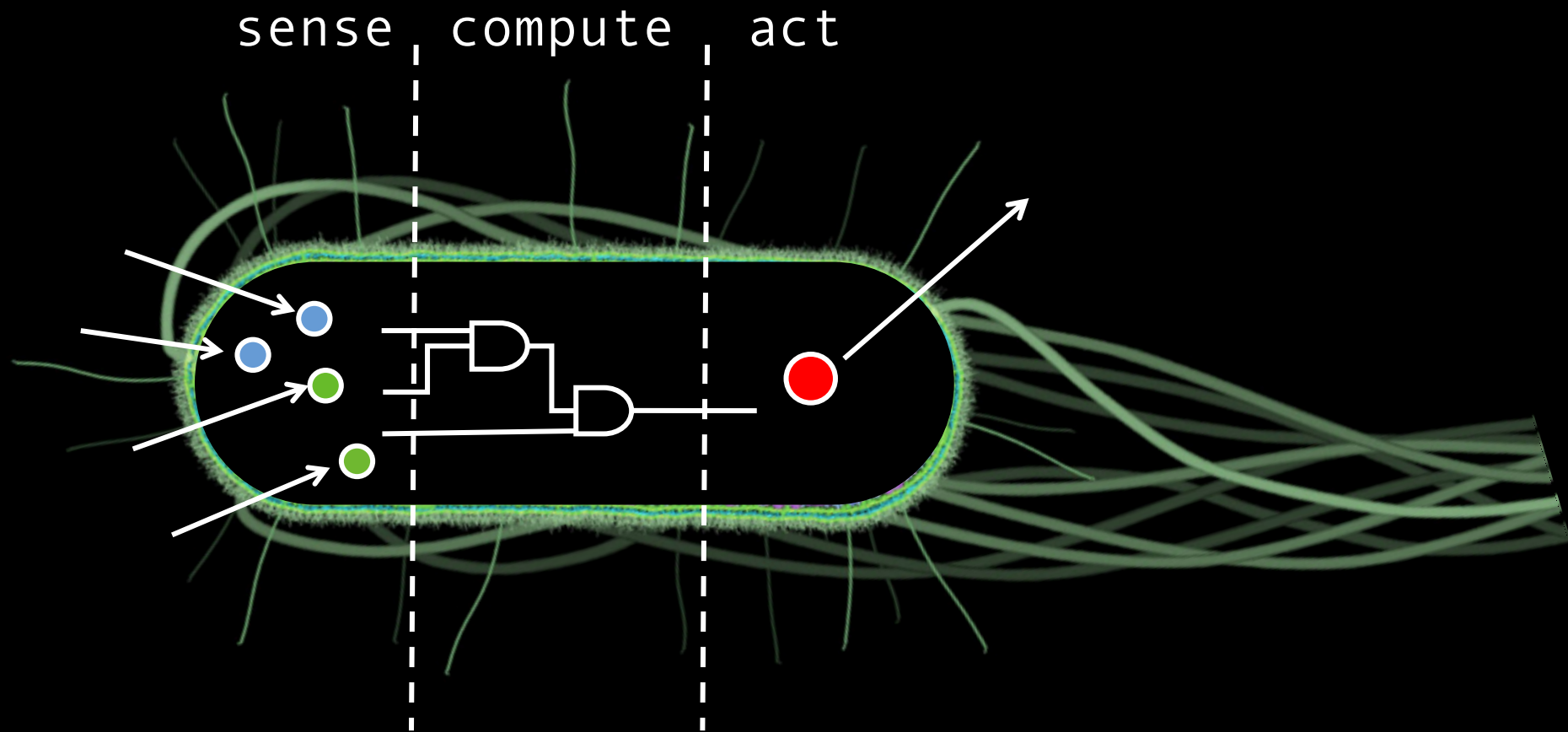# does the medicine work on me?

organ-on-a-chip

1000 organer

Mimetas, the Netherlands

Healthcare Innovation, 2017

biocomputer

biocomputer - lab-in-a-cell
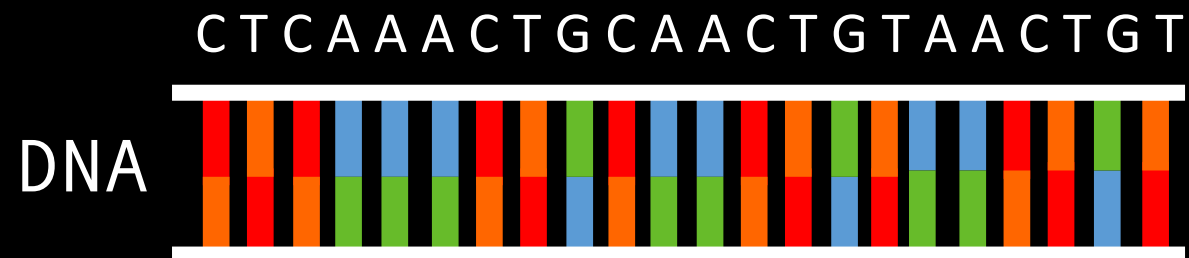

sense   compute   act

biocomputer - lab-in-a-cell

$$1.000.000.000 \text{ in } 1mm^3$$

programming the biocomputer?

```
if (disease detected) then
    do release drug
else
    do nothing
```
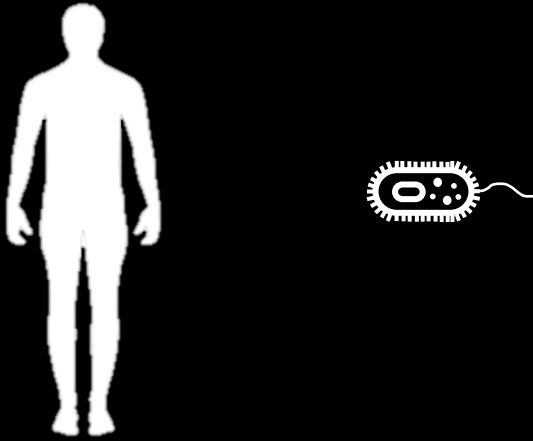
CTCAAACTGCAACTGTAACTGT

DNA

living pill

Psoriatic lesion

anti-Inflammatory drugs
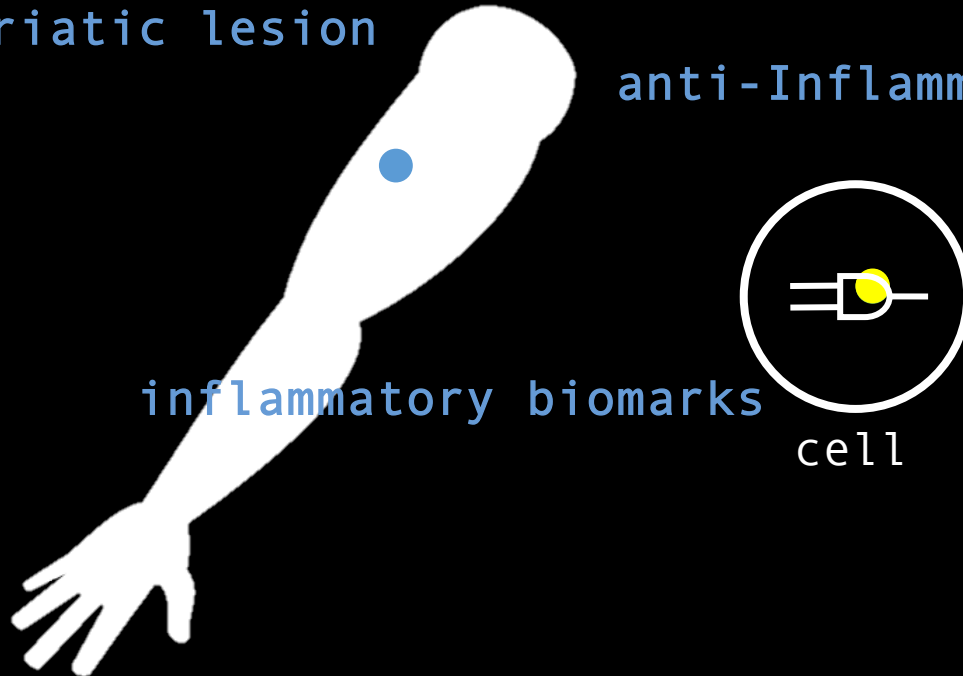
```
if (TNF AND TL-22) then
    do TL-4, TL-10
else
    do nothing
```

inflammatory biomarks

cell

L. Schukur, B. Geering, G. Charpin-El Hamri, M. Fussenegger, **Implantable synthetic cytokine converter cells with AND-gate logic treat experimental psoriasis**. Sci. Transl. Med. 7, 318ra201 (2015).

lab-in-a-cell

"The future is already here - it's just not evenly distributed."

William Gibson

✉ jama@dtu.dk

🐦 @jan_madsen