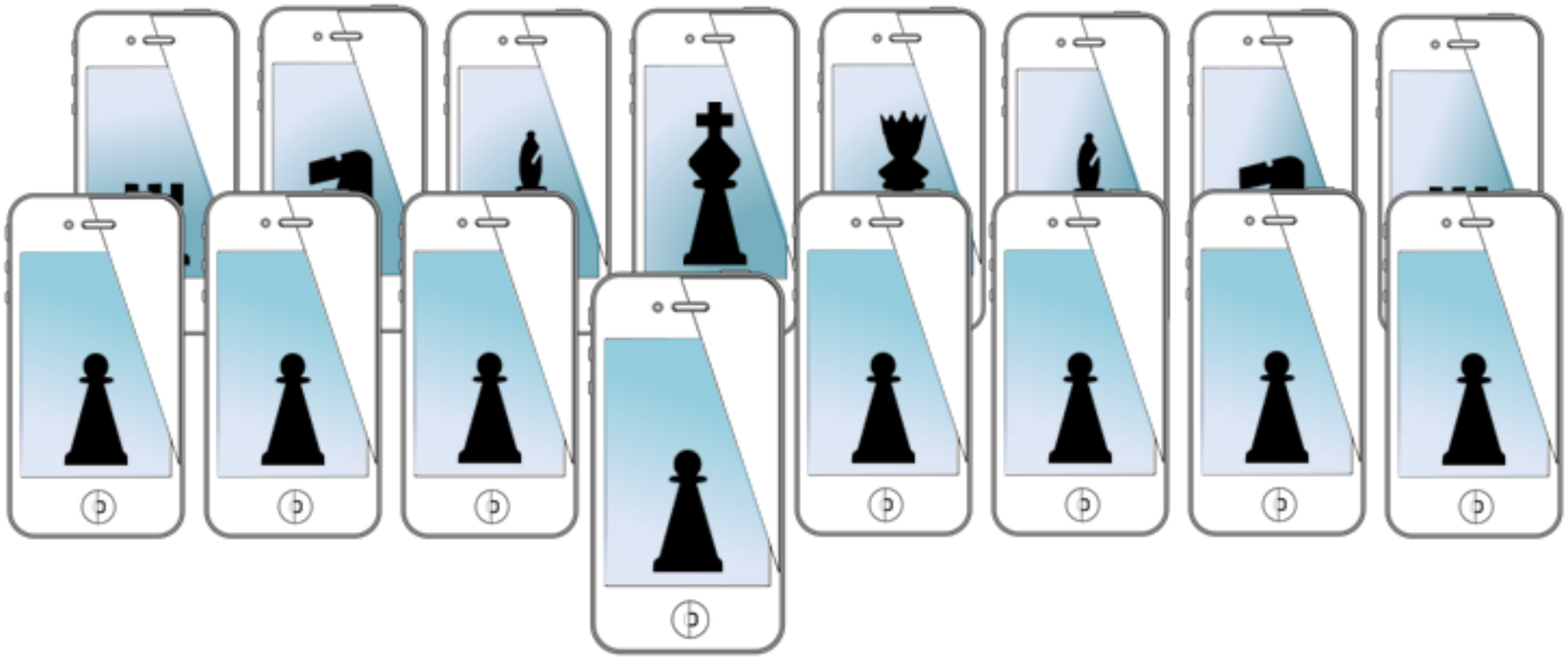
MOBILE SENSING LEARNING



CS5323 & 7323

Mobile Sensing and Learning

computer vision with core image

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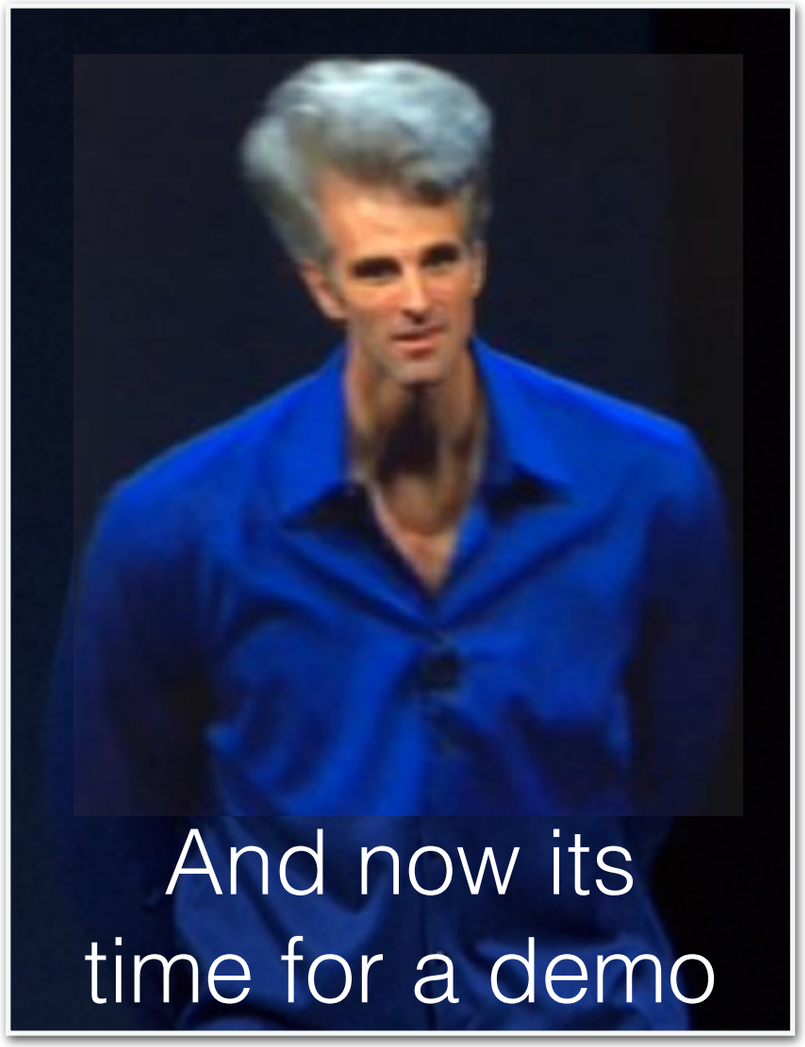
course logistics

- A3 is due soon!
- **class schedule: in-class assignment, OpenCV**

review: face demonstration

- PinchMe++



review: face detection

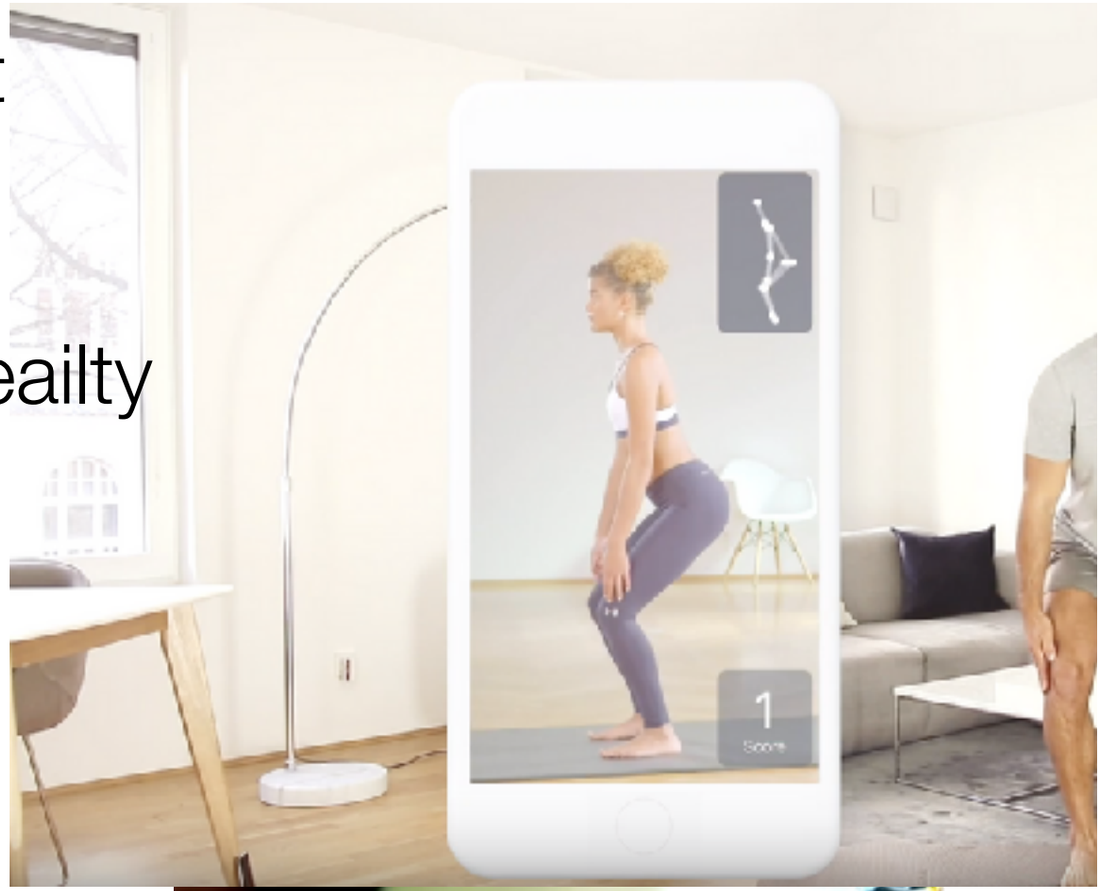
- many tracking mechanisms are supported
- eye location
- mouth location
- smile detection
- blink / wink detection for each eye
- **then**: a variant of the Haar Wavelet method
- **now**: probably deep convolutional learning

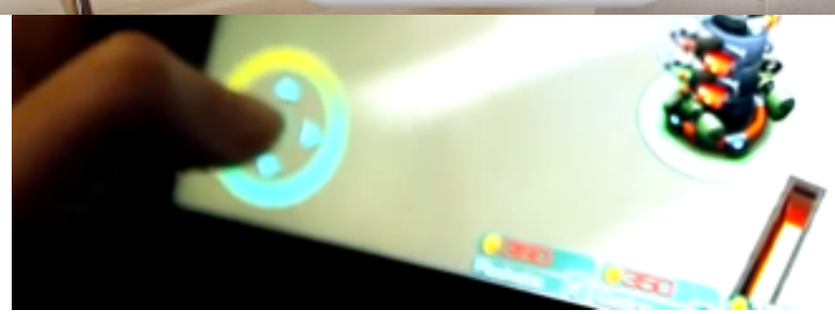
computer vision

- face detection is just the beginning
  - could use tracking method for any object
- could also do “recognition”
  - typically done with eigen-faces or fisher-faces
    - would take (slightly) too much time in this class to implement
- more than just tracking
  - edge detection
  - finding lines and shapes
  - color space transformations
- extract “knowledge” from a scene

computer vision in iOS

- mobile camera is a rich medium for:
  - enhancement
  - interaction
  - augmented reailty
    - gaming
    - tracking
- health

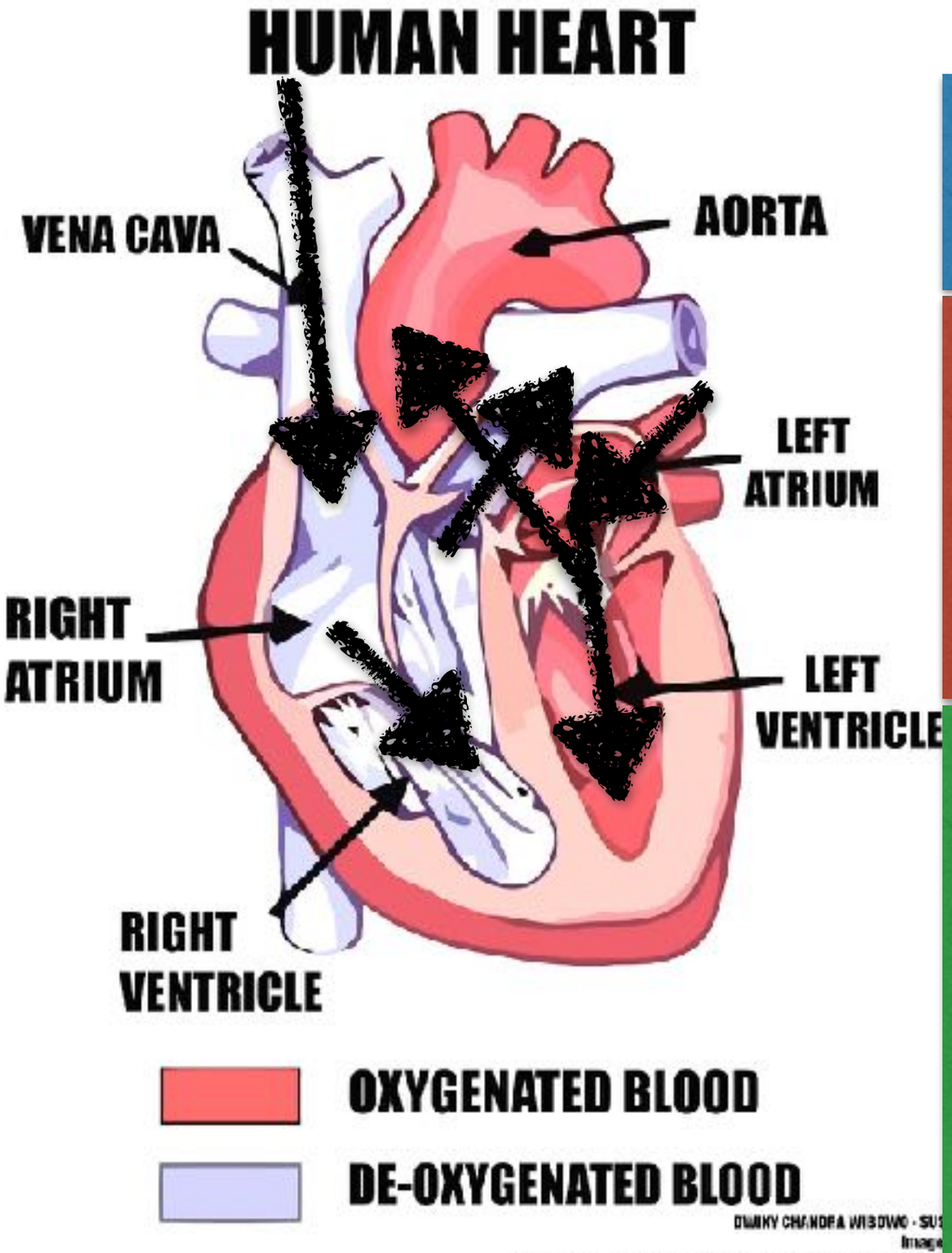




health?

- detecting heart rate from the camera
- what is the function of the heart?
  - pump oxygenated blood from lungs to the rest of the body
  - bring back de-oxygenated blood
- a pump maintains pressure and flow
  - no pump works continuously
  - series of pressure buildup, release, buildup, release
  - cycles in the heart is the **heart beat**

the cardiac cycle

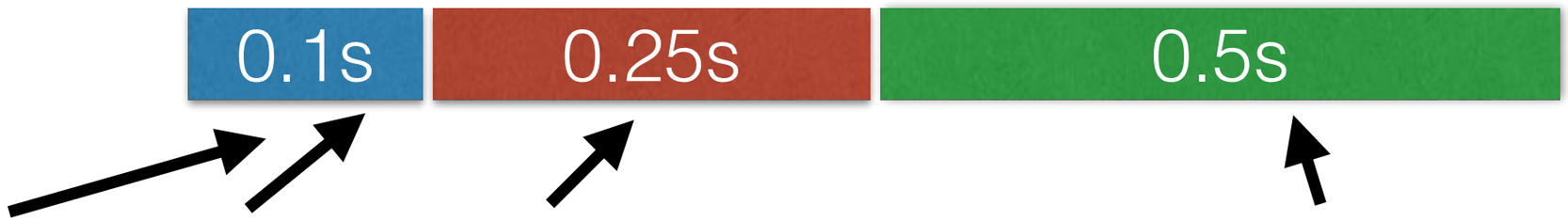


0.1s

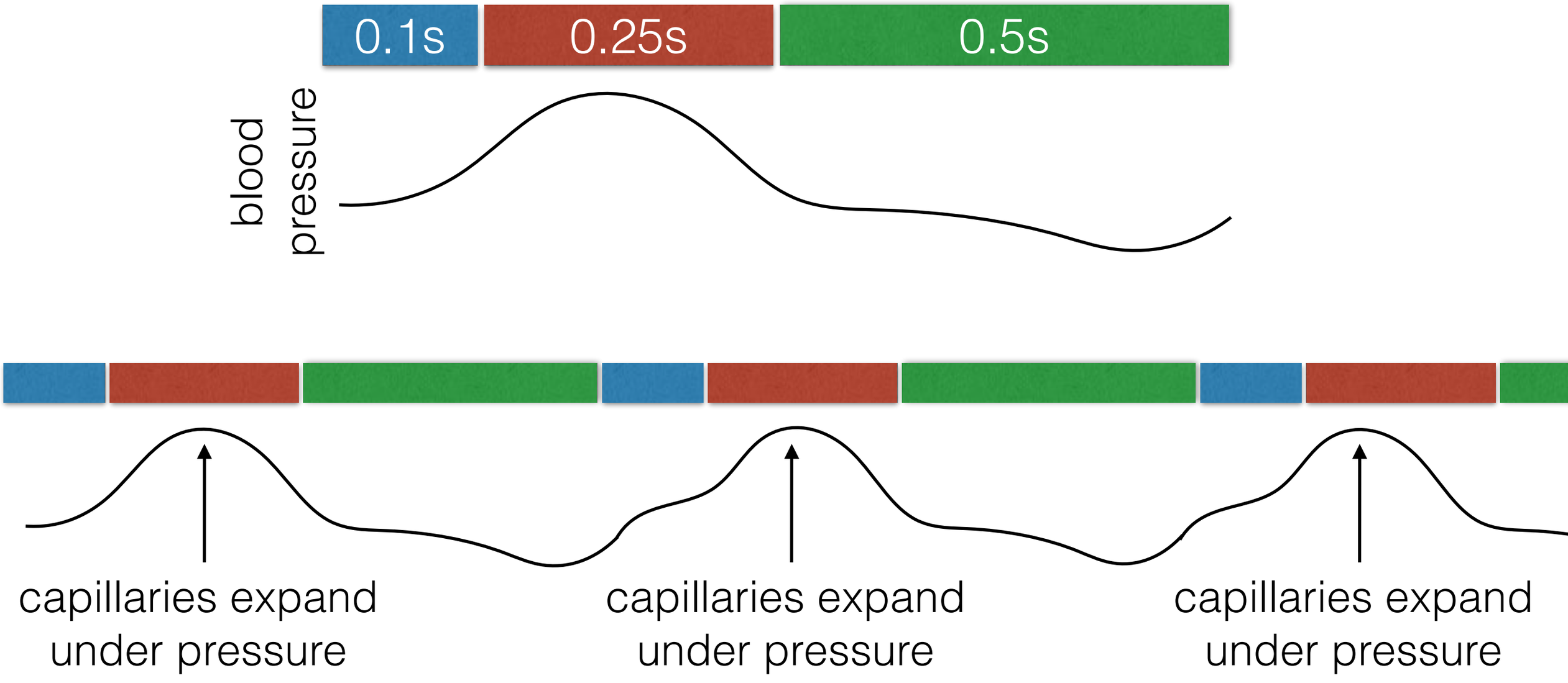
0.25s

0.5s

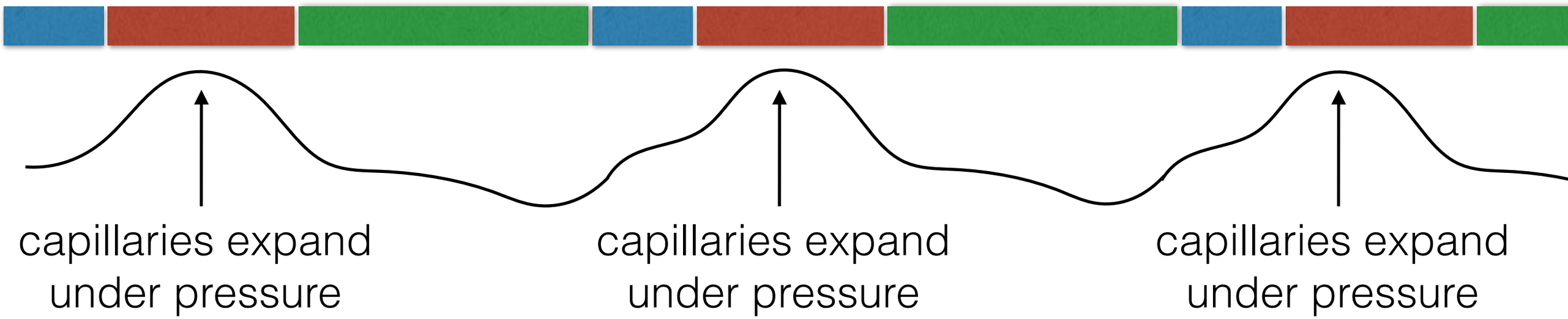
- aortic valve and vena cava valve open
- blood enters ventricles
- pump of heart ejects blood into arteries and out to lungs/body
- heart relaxes, letting blood flow into atria and ventricles


0.1s
0.25s
0.5s

a signal from the heart

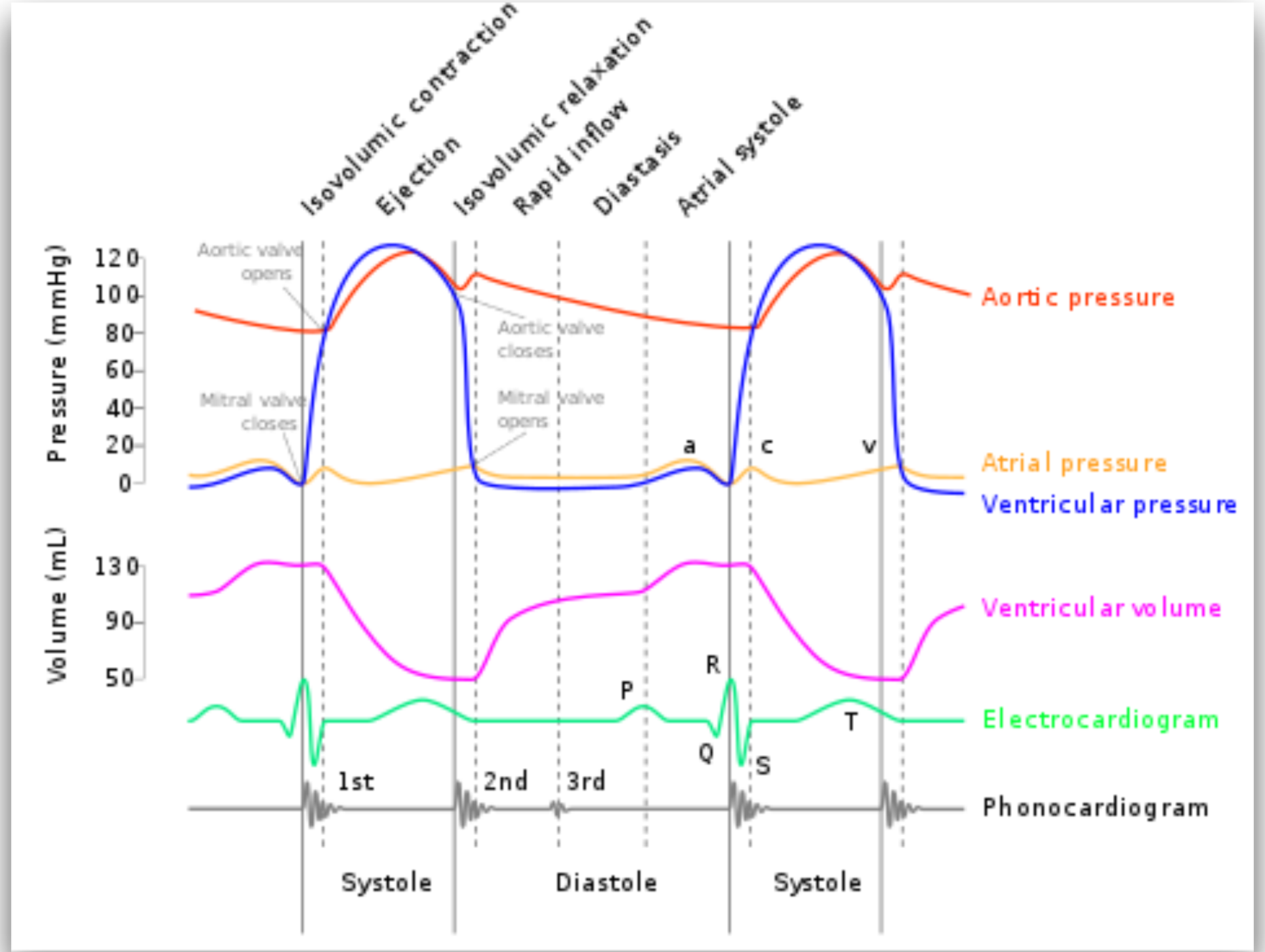


a signal from the heart



- capillary expansion means more blood under skin
  - shift in redness from oxygenated blood
  - shift in blueness from deoxygenated blood
  - more blood molecules for light to reflect from

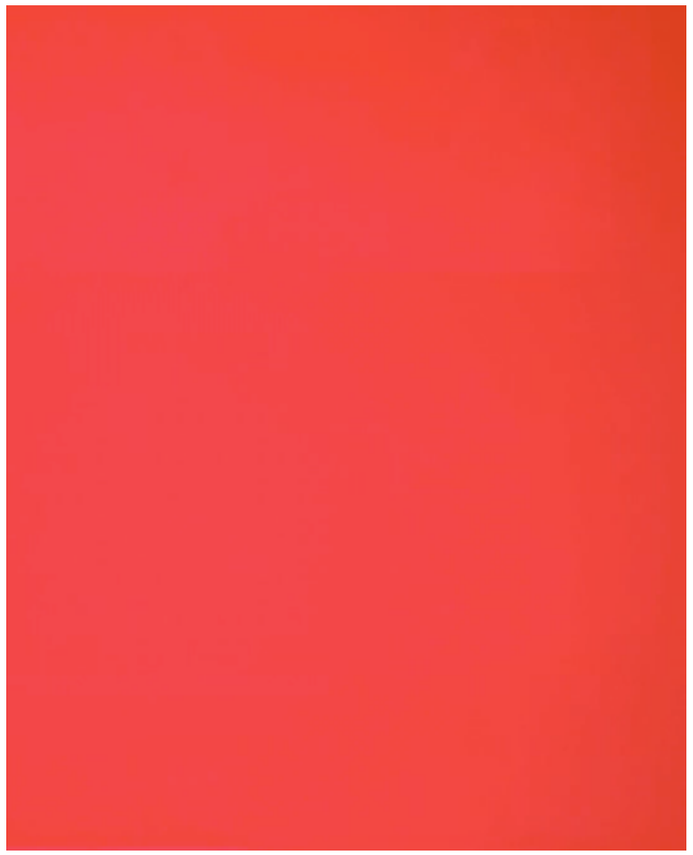
many signals…



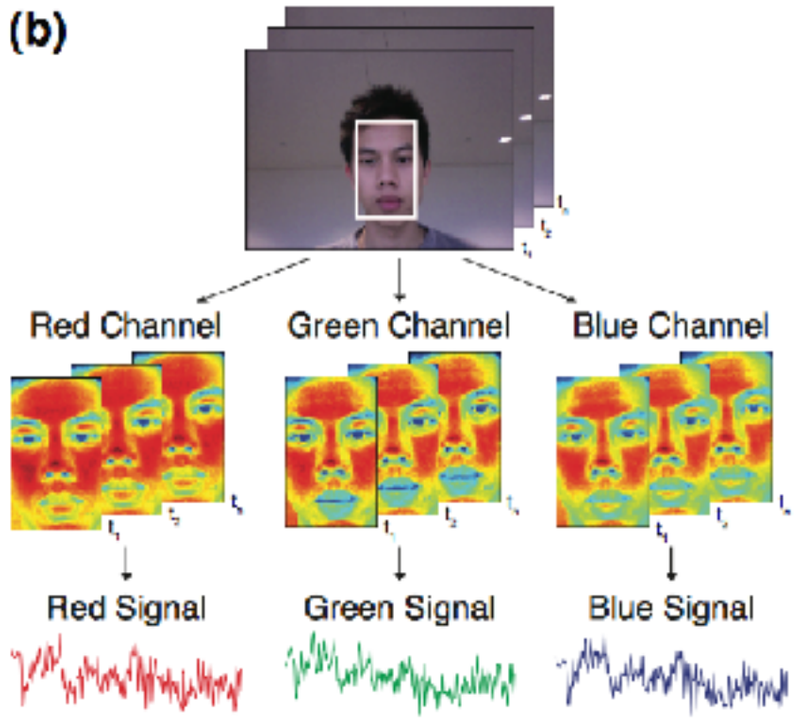
https://en.wikipedia.org/wiki/Cardiac_cycle

a signal from the heart

- hold finger over
  - camera
  - torch (always on flash)



exemplary work



photoplethysmography (PPG)

caveats

- do not press too hard on camera
- vasoconstriction and vasodilation
- bigger surface areas are better
- don’t move around too much
- the heart is not the only organ that increases pressure
  - what else could cause the capillaries to expand/contract?
- what method might you use to measure PPG from the camera?

a cool example

September 7, 2016

HemaApp screens for anemia, blood conditions without needle sticks

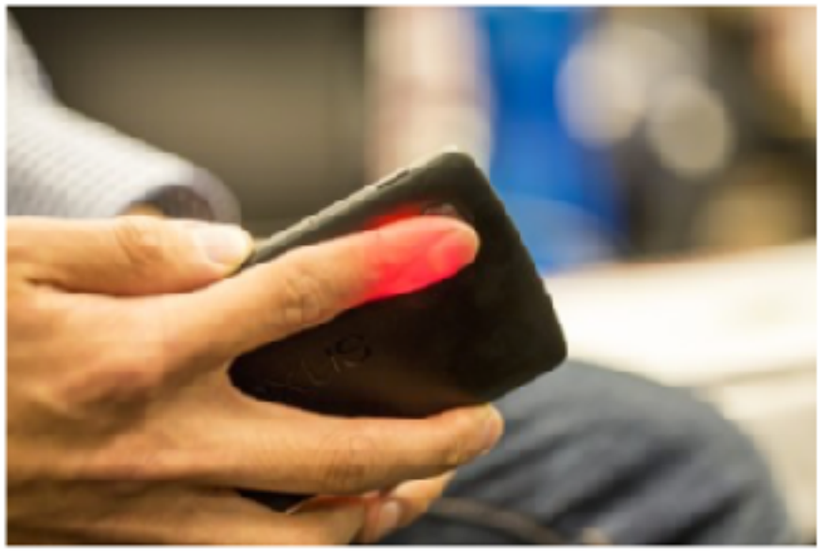
Jennifer Langston

News and Information

In the developing world, anemia — a blood condition exacerbated by malnutrition or parasitic disease — is a staggeringly common health problem that often goes undiagnosed.

In hospitals everywhere, children and adults with leukemia and other disorders require frequent blood draws to determine if they need blood transfusions.

In both cases, doctors are interested in measuring hemoglobin, a protein found in



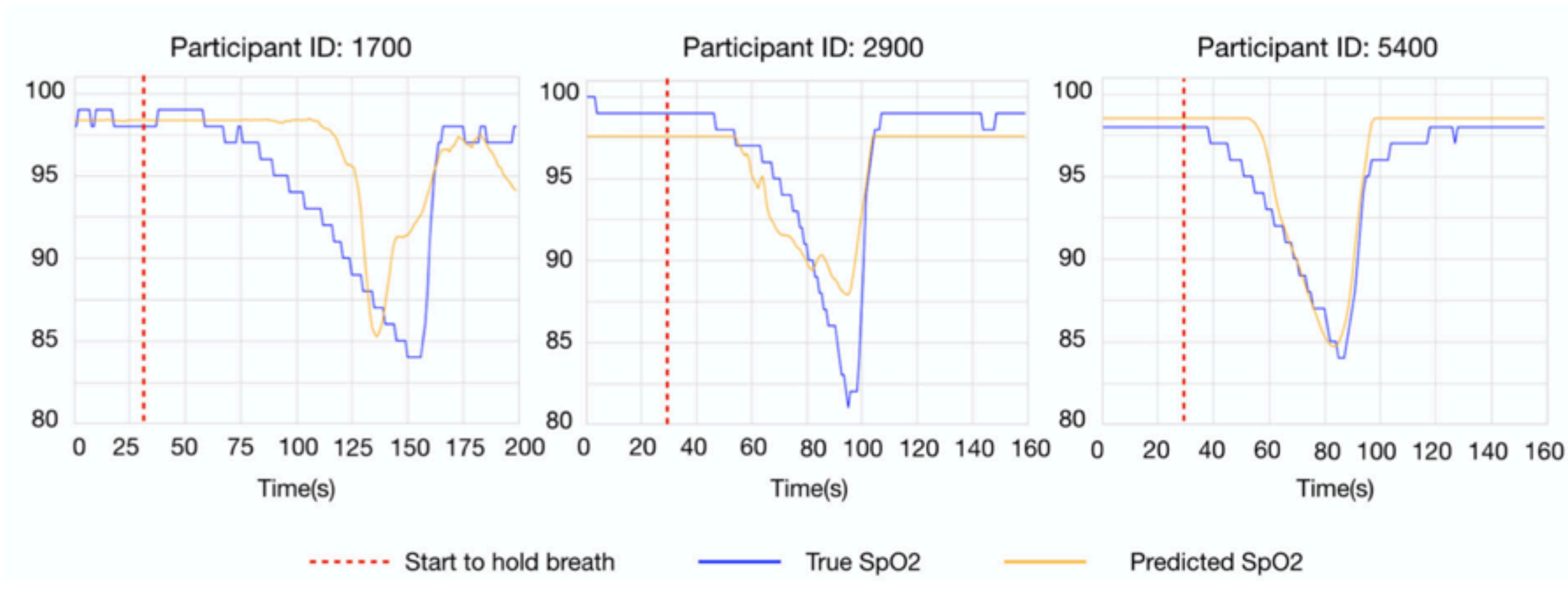
HemaApp measures hemoglobin levels and screens for anemia non-invasively by illuminating the patient's finger with a smartphone's camera flash. ***Dennis Wise/University of Washington***

a research project

Measuring Oxygen Saturation With Smartphone Cameras Using Convolutional Neural Networks

Xinyi Ding, Damoun Nassehi, and Eric C. Larson

Fig. 1. Experimental setup of ground truth pulse oximetry data collection and custom phone application.

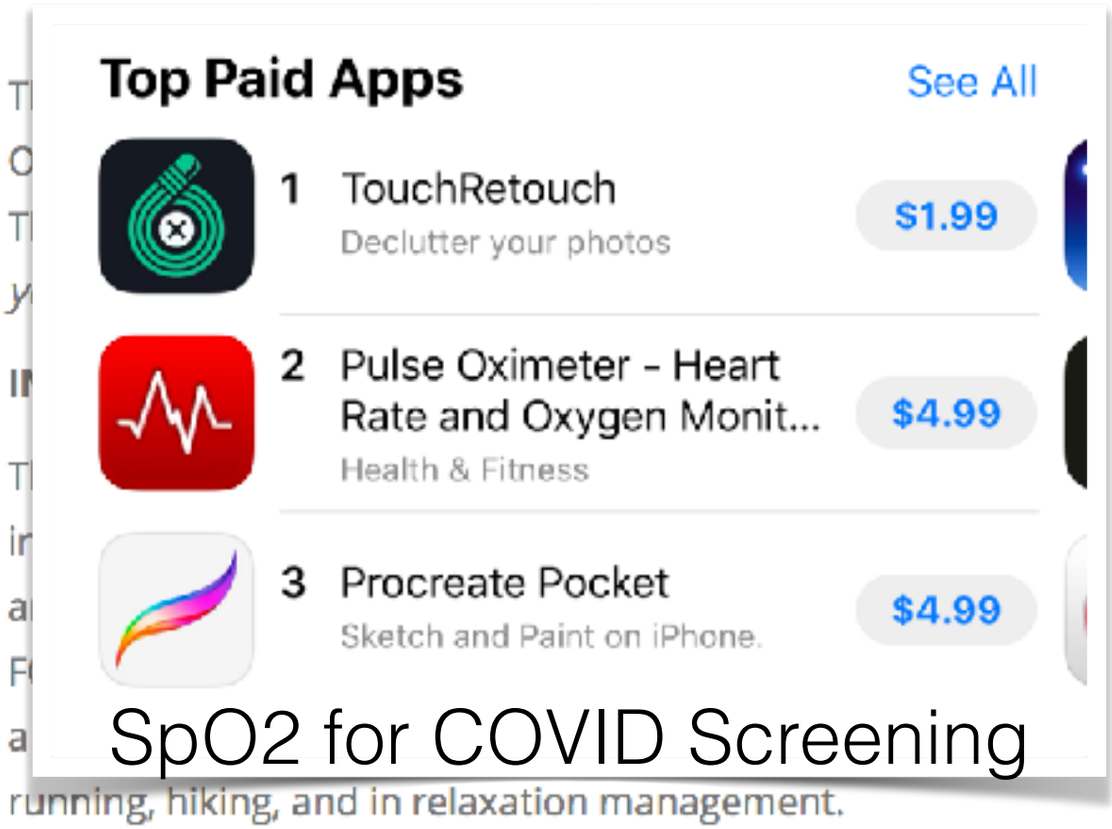


another cool example

digiDoc Technologies

Home Products

The World's Only Digital Solution



SpO2 for COVID Screening

running, hiking, and in relaxation management.

Pulse Oximeter uses your iPhone's camera to detect your pulse and oxygen levels from your fingertip. Track and record heartbeat and blood oxygen levels. Instant results, easy to use, simple charts to save your progress.

Features

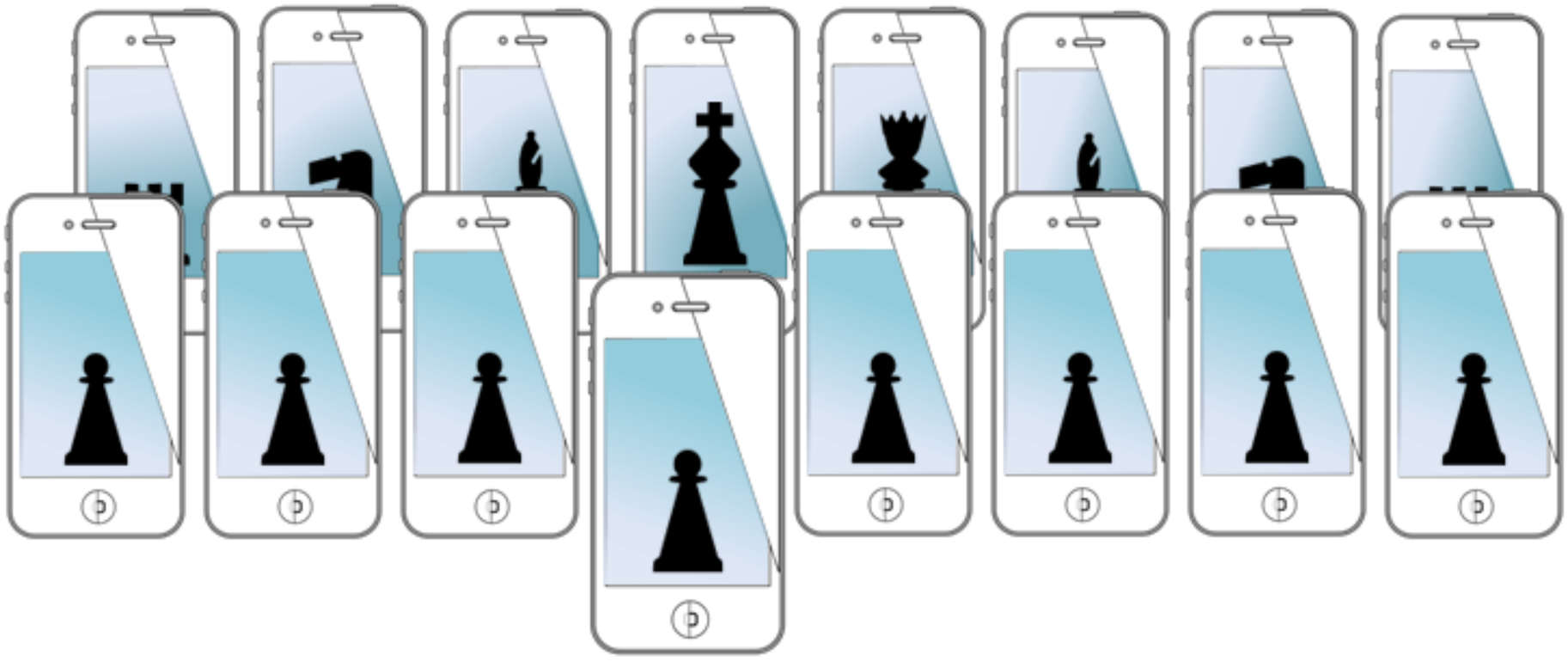
- Measure pulse and blood oxygen saturation
- Pulse Oximeter range 93-100%
- Record and store history of data
- Real-time PPG graph for immediate accuracy
- Apple HealthKit integration
- Label selection

Download on the App Store

for next time…

- flipped module!
- computer vision with OpenCV
  - watch video lecture for OpenCV
  - fun operations in imaging
  - come ready to use OpenCV next time

MOBILE SENSING LEARNING



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