CIS373 - Pervasive Computing Introduction

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Adapted from materials provided by Xiang Cao and Rob Parke (USC)

Overview

- Welcome!
- Syllabus
- Pervasive computing

What we ***will*** cover

Forms of computing that are most directly associated with being pervasive

i.e., Internet of Things (IoT)

Theoretical concepts

i.e., you study things

Practical concepts

i.e., you do things

What we will ***not*** cover

In-depth programming

- For programming tasks, I'm going to make the assumption that you know a base level of programming
  - Though I will most likely give you supporting code to help you along
  - Especially since we're programming in CircuitPython...

What do you want to cover?

Knowledge you are **assumed to have**

Ability to work **individually and on teams**

- You're an adult, I also expect maturity and even effort-sharing where necessary

Ability to **talk to me if you have problems**

- Don't be nervous, I am very approachable!

How class will *generally* work

Our classes are a **single** 3 hour session per week

- Classes will be a mix of:
  - Lecture
  - Discussions
  - Labwork
    - Guided/self-guided work

Subject to change based on material, naturally

- But, I want you to get **practical experience**

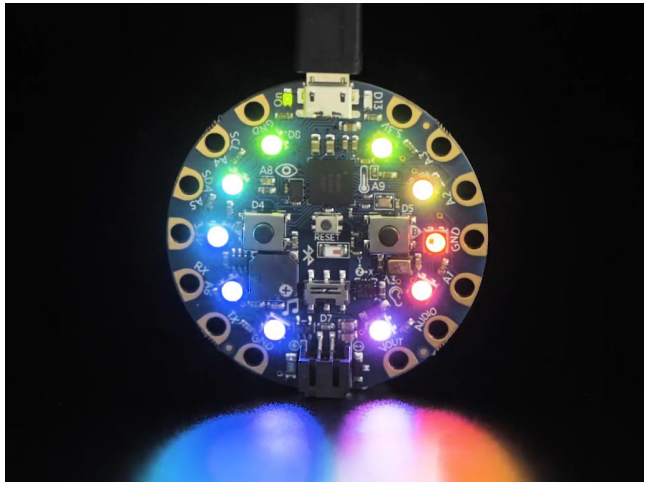
Also, typically we'll take a ~10 minute break each "hour" of class

And what *exactly* are these things you had us buy?

Circuit Playground Bluefruit - Bluetooth Low Energy

Nifty little Arduino devices that include:

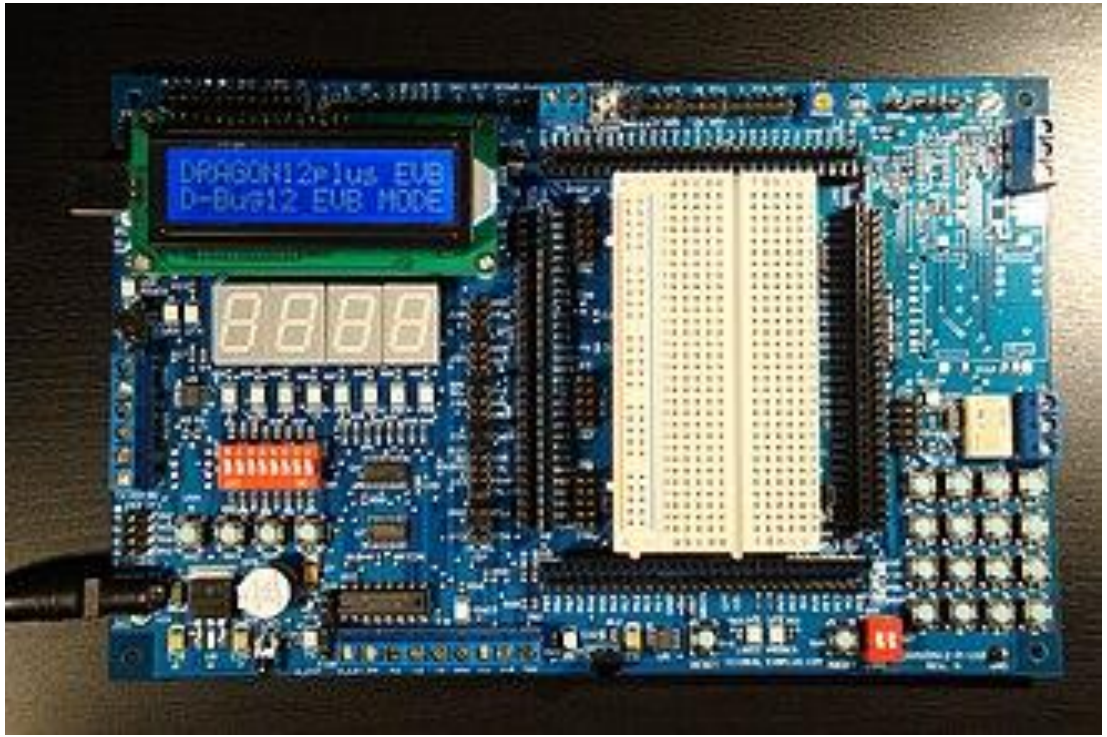
- NeoPixels
- Buttons
- WiFi/Bluetooth
- Temperature / light / gyro sensing
- Speaker
- Capacitive touch
- ...



https://www.adafruit.com/product/4333

(i.e., way more impressive than what I had when I was an undergrad...)

Motorola HC12 dev board




PROJECTS

You will develop a half-term project

Goals of this project:

1) Have something portfolio-worthy at the end

2) Apply IoT skills using either our device (Bluefruit) or any simulation/device of your choosing

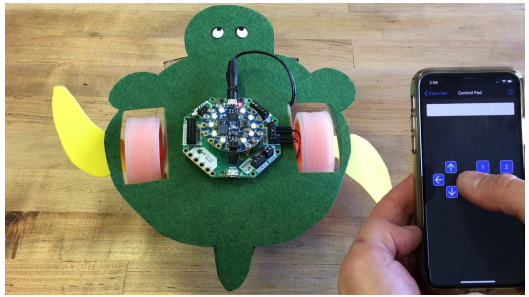
3) We'll start around midterm time, but start jotting down things that interest you

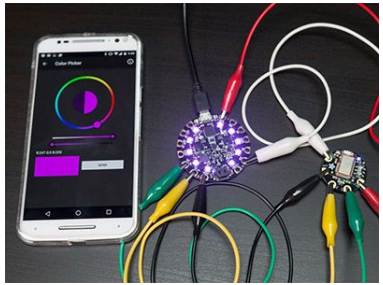
WHAT SHOULD I DO?!?!?

Anything that fits the brief of an IoT project

Looking for ideas? Search for 'maker' topics and you'll find a plethora of options

- There are a metric ton on the Adafruit website as well...
- Just ensure if you are using some existing demo that you extend it in some way





Wait, there's options?

You have **three options** for your term projects

1. You do a "normal" project of your choosing, either alone or on a small team

Extra credit for extra effort:

2. You do a collaborative project with classmates in an Interactive Media course that most likely would result in an art installation/exhibit

3. You do undergraduate research that has the *possibility* to result in an academic publication

Our tech stack

Class is **synchronous in-person**, meaning:

1) Class runs at specific days/times
2) Office hours are in-person (can be online) as well

Class website: Blackboard // https://gvsu-cis373.github.io/gvsu-cis373/
Async Chat: Discord // not required, but a decent place to chat
Term projects: GitHub

If you want to get a hold of me for questions:

- Ping me in Discord
- Email me
- Visit office hours (virtual or in-person (generally))

Syllabus

As always, the syllabus is **worth reading**

Important topics like:

- When is my final exam?
- What is the grading breakdown?
- What time does this class meet?
- Where can I find the nifty textbook?
    - hehehhehehe
        - heh

Questions so far?

burgertv:

> Tina asking the important questions

Source: burgertv

So...

What programming languages do you know?

And so...

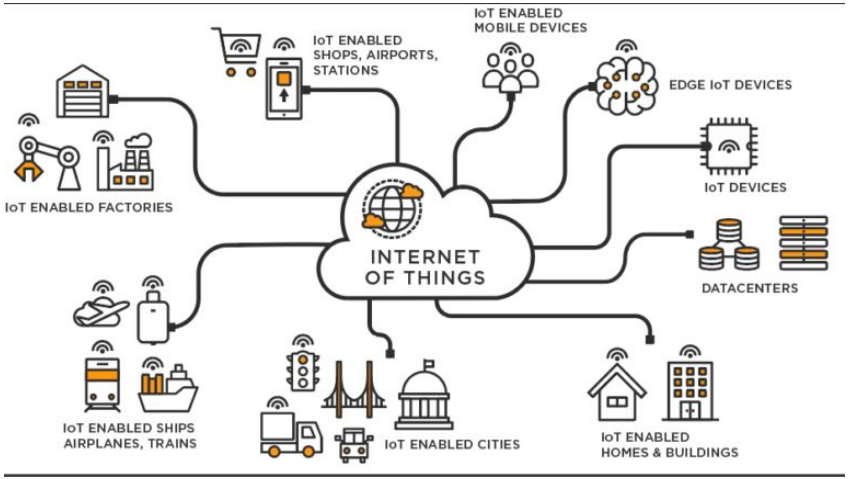
What do **you** think of when you hear pervasive computing / IoT?

So, what **is** pervasive computing / IoT

Network of physical objects

- Devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity

- Enables these objects to collect and exchange data.



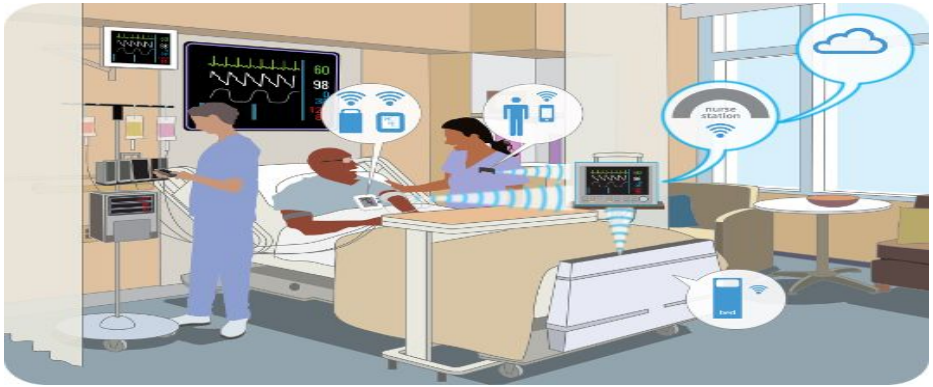
https://www.youtube.com/watch?v=6mBO2vqLv38

What are some sample IoT applications?

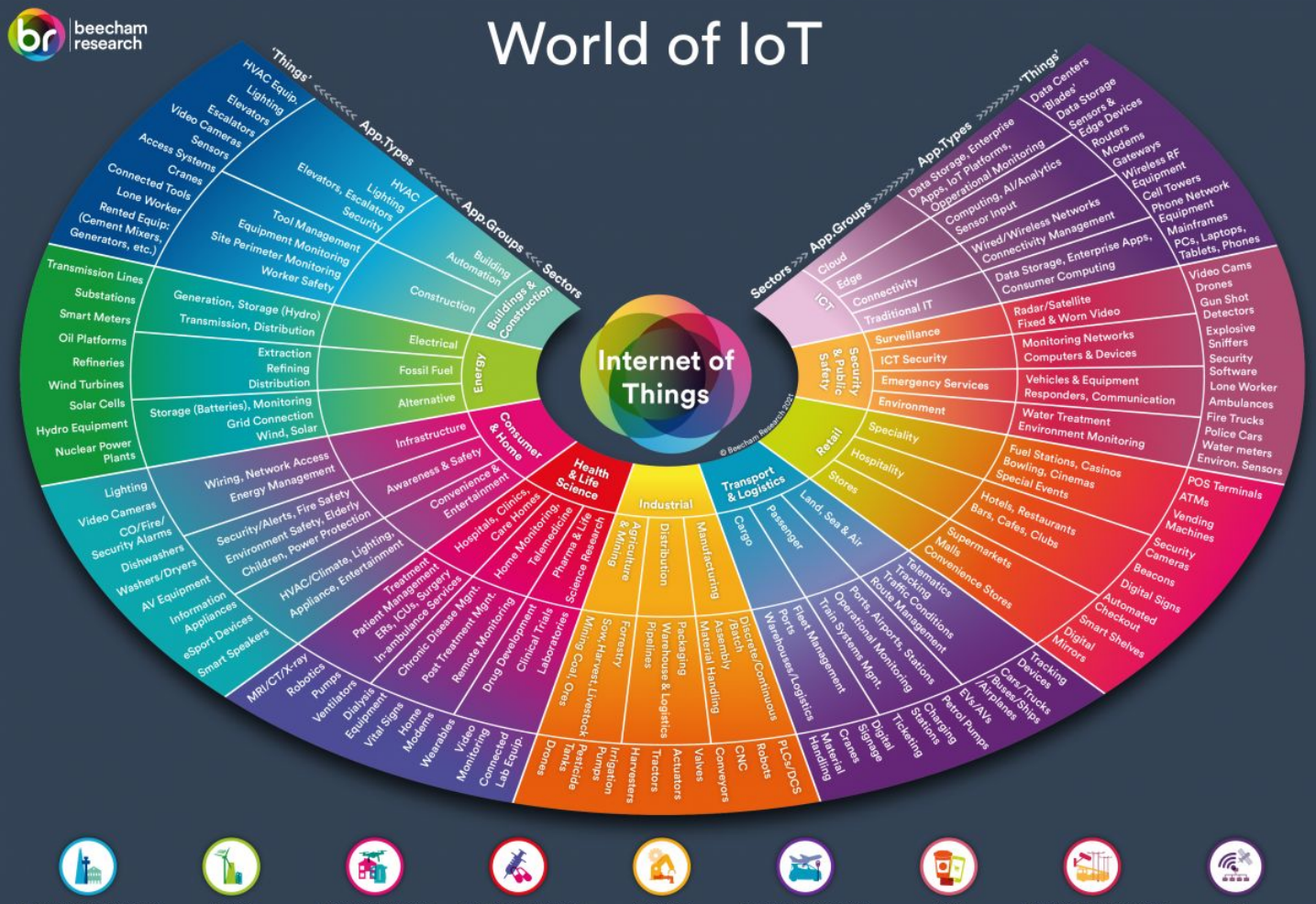
https://www.techtarget.com/iotagenda/tip/Top-8-IoT-applications-and-examples-in-business

Wearables

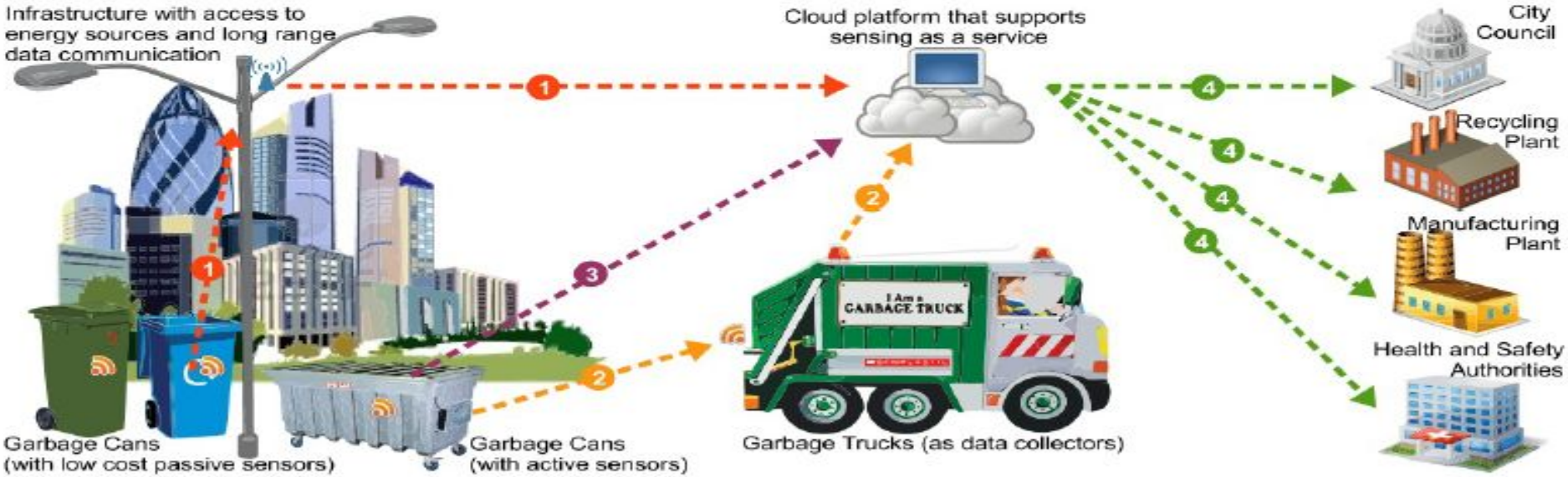
Smart devices



Healthcare


beecham research
World of IoT
'Things' <<<<<<< App.Types <<<<<<< App.Groups <<< Sectors
Sectors >>> App.Groups >>>>>>> App.Types >>>>>>> 'Things'
Internet of Things
© Beecham Research 2021
Buildings & Construction
Energy
Consumer & Home
Health & Life Science
Industrial
Transport & Logistics
Retail
Security & Public Safety
ICT
https://www.beechamresearch.com/

Efficient Waste Management in Smart Cities Supported by the Sensing-as-a-Service



[Source: "Sensing as a Service Model for Smart Cities Supported by Internet of Things", Charith Perera et. al., Transactions on Emerging Telecommunications Technology, 2014]

Cow

In the world of IoT, even the cows will be connected and monitored.

- Sensors are implanted in the ears of cattle.
- Farmers to monitor cows' health and track their movements
    - - ensuring a healthier, more plentiful supply of milk and meat for people to consume.

- On average, each cow generates about 200 MB of information per year.

IOT Application Scenario - Shopping

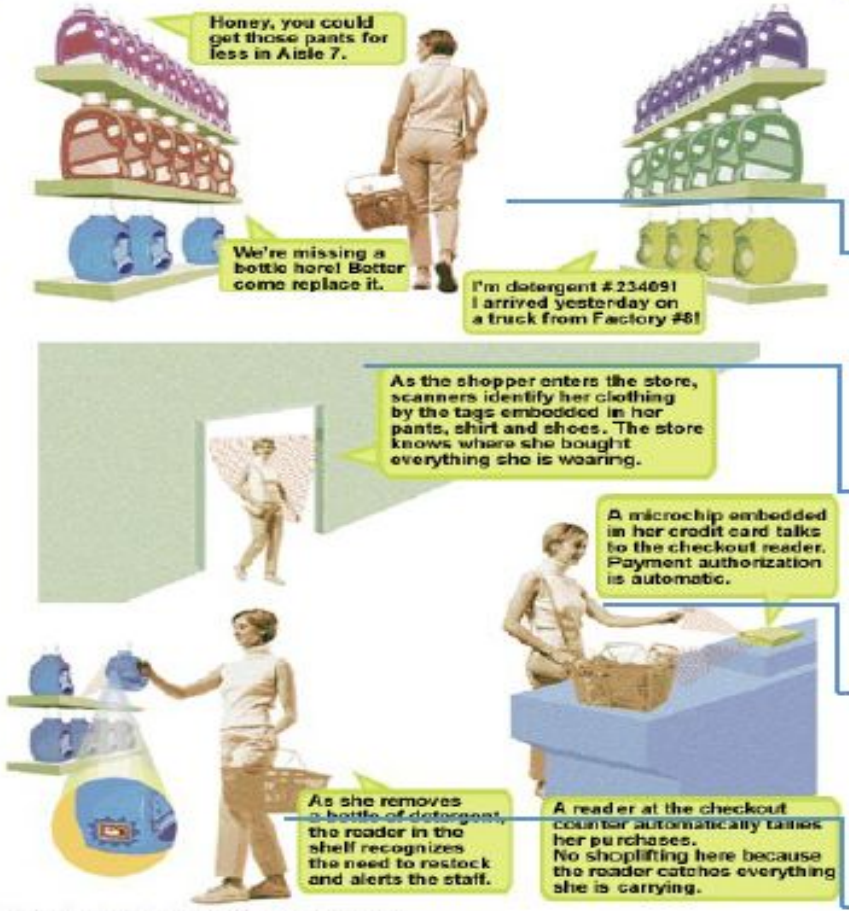


Illustration by Lisa Krouse Brahman for Forbes

https://www.youtube.com/watch?v=NrmMk1Myrxc

(2) When shopping in the market, the goods will introduce themselves.

(1) When entering the doors, scanners will identify the tags on her clothing.

(4) When paying for the goods, the microchip of the credit card will communicate with checkout reader.

(3) When moving the goods, the reader will tell the staff to put a new one.

How Well Do I Sleep?

Sleep

zzzZ

YOUR SLEEP EFFICIENCY
92%

Your sleep pattern asleep awake

You went to bed at	Time to fall asleep	Times awakened	You were in bed for	Actual sleep time
11:00PM	0min	20	6hrs 40min	6hrs 6min

8 h 50 mins asleep

1d 1w 1m 3m 1y

- Awake for 212 mins (81x)
- Restless for 278 mins (91x)

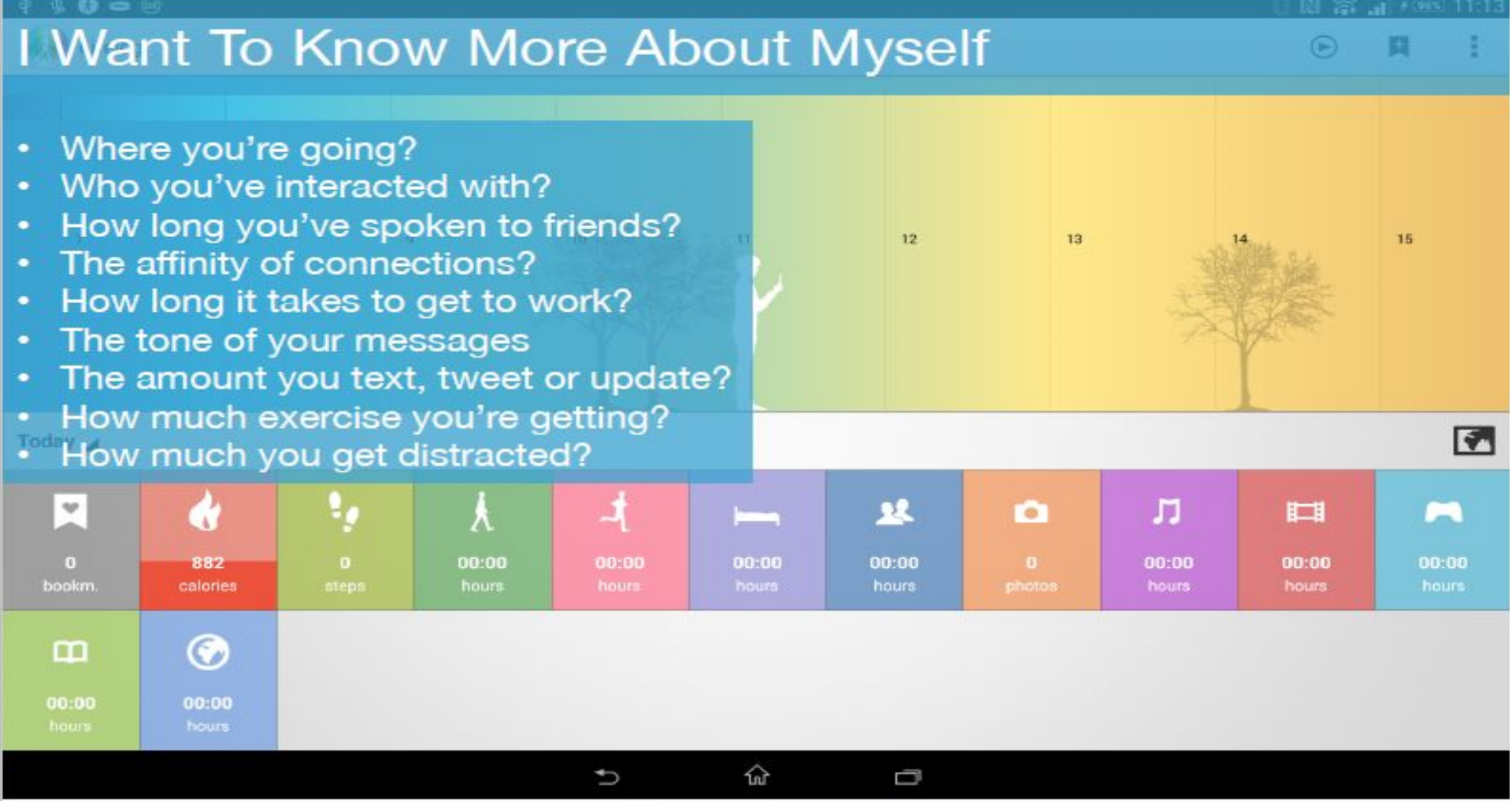
Thursday, February 27

Sleep Stats

Time asleep over the past 30 days in hours

Times awoken over the past 30 days

fitbit flex
Wireless Activity + Sleep Wristband



Can Internet of Things (IOT) Help Us To Know More About Ourselves?

How does it work?

IoT isn't a single technology - it is **multiple** technologies working together

- Communication and cooperation
- Addressability
- Identification
- Sensing
- Actuation
- Embedded information processing
- Localization
- User interfaces

What are some devices you can think of?

Think: maker

Why study IoT?

Why learn this?

Jobs (2020 data)

- 4.5 million Internet of Things (IoT) developers
- 57% annual growth rate
- 26 billion Internet nodes (excl. phones, tablets, and computers)
- 30 fold increase from 2009

2025: projected 42 billion IoT devices globally

Cross-discipline

CS, EE, data analytics, product design, entrepreneurship, making

https://reparke.github.io/ITP348-Physical-Computing/lectures/week01/lecture_intro_making_smart_devices.html

Why learn this?

Industry opportunities

- Companies and organizations are using open source tools to build devices (even NASA has used Arduino)
- Former company used Raspberry Pis in development
    - (Hopefully just in development...)

Companies are looking for people who know these technologies!

https://reparke.github.io/ITP348-Physical-Computing/lectures/week01/lecture_intro_making_smart_devices.html

Safety

This device is a **printed circuit board**

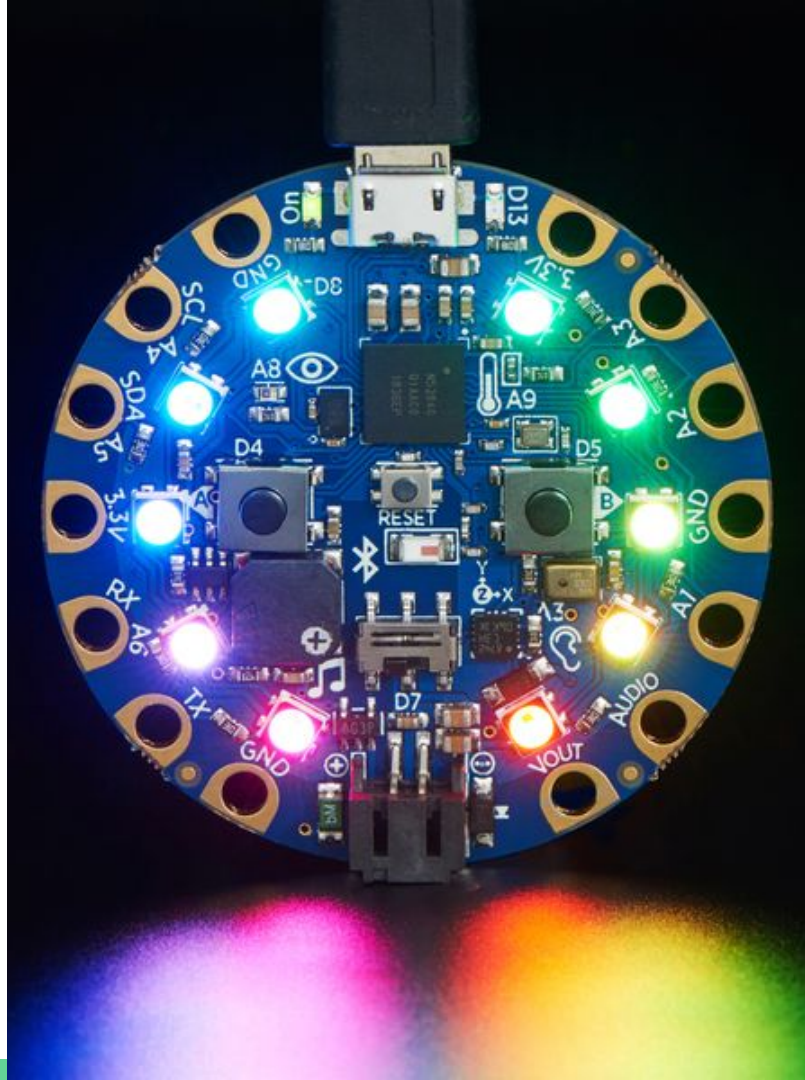
It is **fairly resilient** against static electricity, but still be careful

- Avoid building up shock
  - Touch metal before touching device to dispel static

- Avoid touching the board directly if you can

- Be alert and focused

https://learn.adafruit.com/adafruit-circuit-playground-bluefruit?view=all



Safety

Recommend pulling power before adding/removing any external wires (alligator clips)

Always double-check your wiring / connections before powering on

If you see or smell smoke, anything burning, anything *odd,* **disconnect power/USB immediately**

Ensure your USB cable is:

1) Correct - charging-only cables aren't going to transfer data
2) Not damaged - avoid back-feeding power into your computer

And last but not least

When transporting, keep the Circuit Playground in its electrostatic baggy
- Protects against shock building up during transport

Or get it a nice case...
https://www.thingiverse.com/thing:2585702

The paper!

Mark Weiser - The Computer for the 21st Century - 1991

Questions:

1) How do we know "where" a device is?

But first

Couple of gotchas with Mu editor that I've noticed

1) It **does not like infinite loops**

Make sure you save your code often - if it locks up and your code hasn't been saved...

2) It does not like **printing to serial every loop**

I've noticed it slows down quite a bit if you print every loop iteration without a delay
Recommend adding a call to `sleep(1)` while debugging...

Lab #1 - Getting Started with the Bluefruit Express

Online guide here: https://efredericks.github.io/gvsu-cis373/labs/

The plan:

1. We will work *a bit* of the online material to get you up and running
2. You are going to extend what we've done today for your homework (Blackboard)
3. You're also going to answer some questions in the lab manual (Blackboard)

My suggestion:

Work through the lab manual at your own pace - if you don't get through it all tonight that is **fine!**

And if I'm going to slow feel free to speed ahead

Just ensure you know what you're doing before you leave.

And that you've shown me your work to be done before end of class

I will work through it at what hopefully isn't too fast of a pace (or too slow...)

What about this?

We may look into this...but not today