ELEC 391 – Project description, expectations, requirements, timeline
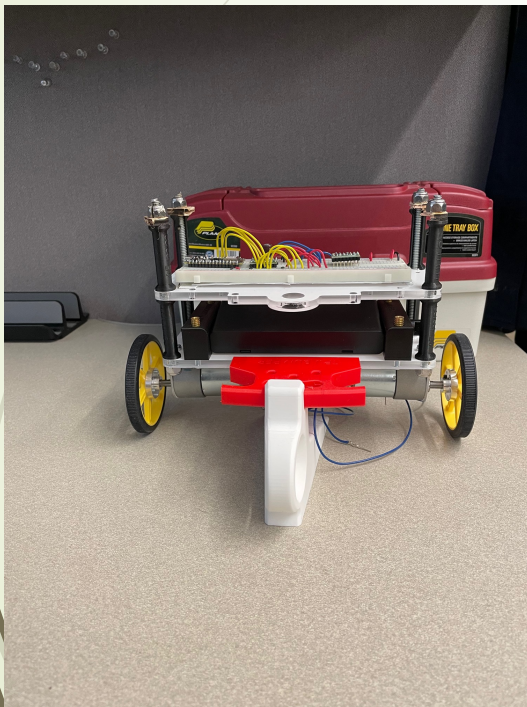
2024W2

Labs this week

- continue working on the starter assignments
- watch PCB videos, study for the PCB quiz
- finalize your groups
  - by next Monday morning, students without a group will be assigned one
- when you have formed your group, ask the Tas for an Arduino kit

Project platform– two-wheel self-balancing bot

Project description

- Core portion with pre-defined requirements
- Extra-features portion (mini-project within project)
  - each group defines their own requirements
  - worth 20% of course grade
    - proposal - 5%
    - final demo + report – 15%

Project description – core part

week 4 - 6

- Assemble bot from pre-made parts kit
- Add electronics/electromechanical parts to bot
- Demonstrate basic measurements, motors control

week 8 - 14

- Implement balancing control
  - includes simulations
- Implement BLE remote control
  - forward, backward, right and left turns
- Integrate core & extra-features
- Demonstrate design, validate requirements

Core requirements

- Terminology: Goals, Requirements, Constraints
- **Goals**: Design and fabricate a self-balancing robot on two wheels that is able to maintain balance in a vertical position while being driven remotely by an external operator on a course track
- Goals are formulated at high level, avoiding jargon or abbreviations
- Capture the essence of product or design
- Are described in terms of outcomes, not work
- Bad example of a goal: spend 13 weeks working on this course, spend up to $1000 for budget
  - described in terms of inputs (work, $$$), rather than outcomes

Core requirements

1. The robot must be able to balance itself when disturbed from the vertical equilibrium position with an angle of up to 15 degrees.

2. The robot must be able to maintain balance while driven by an external operator at a reasonable speed.

3. The robot must be able to maintain balance while taking turns statically and at reasonable speed.

4. The robot must be able to move forward and backward under external remote control.

5. The robot must be controlled externally by BLE wireless signal. Four controls (forward, backward, turn left, turn right) must be implemented.

6. Additional requirements: to be defined by each team at the time of proof of concept demo
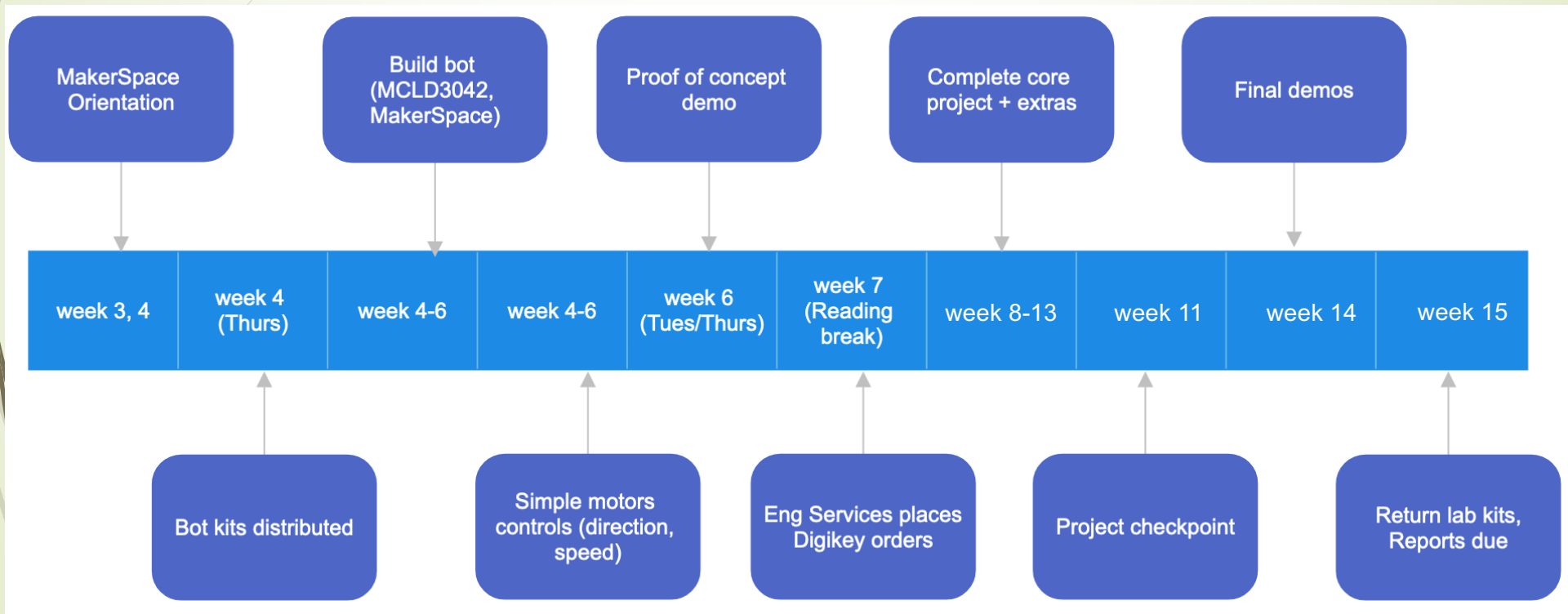
Core requirements

- Consider these as v0.1 of a "Requirements" document
- In real-life projects, usually the result of initial-stage discussions with a client
- Need to be refined iteratively
    - i.e. many details need to be identified and clarified
- Project/design is considered successful if goals and requirements can be validated in full (i.e. the design meets the goals/requirements)
- Need to define the validation process!
    - either by designer (engineering team) or client

Constraints

- limits within which a project must operate
- typically, six major constraints:
  - time, cost, scope, quality, resources, and risks
- Specific to our project:
  - all teams must use the components kit provided as part of course materials
  - self-proposed (extra) features must fit in a budget of $CAD65 of parts orderable from Digikey, with some qualifiers:
    - no tax, shipping fees etc. included
    - mechanical components fabricated in-house (MakerSpace) not included, check Engineering Services website for details
  - Power source is limited to the battery pack provided in the kit
  - Possibly others...

Project timeline

MakerSpace Orientation	Build bot (MCLD3042, MakerSpace)	Proof of concept demo	Complete core project + extras	Final demos

week 3, 4	week 4 (Thurs)	week 4-6	week 4-6	week 6 (Tues/Thurs)	week 7 (Reading break)	week 8-13	week 11	week 14	week 15

Bot kits distributed	Simple motors controls (direction, speed)	Eng Services places Digikey orders	Project checkpoint	Return lab kits, Reports due

Extra-features (mini-project)

- worth 20% off your course grade
  - proposal – 5% (week 6)
  - demo (week 13); design report (week 14) – 15%
- budget: $CAD 65
- from Digikey online catalog
- before taxes, shipping fees, etc. (paid by ECE)
- can use components/parts from your 2nd year kit(s)
  - evidence required
  - does not count towards the $65

Extra-features (mini-project) – Q&As

Q: "Can I buy my own components outside of Digikey?"

A: Yes, but: **1**.total budget must still be under $65 (evidence required, keep receipts, include in final report); and **2**. Can't guarantee reimbursement (very likely no reimbursement)

Q: "We really want to implement our idea, but costs will exceed $65. Can we still do it?"

A: 1. Eng Services won't accept orders in excess of $65 per team; 2. Any out-of-pocket expense in excess of $65 will attract a penalty of 1% of grade per every $10 spent in excess.

Q: "How do we know what is enough / acceptable for the 20% ?"

A: Good question ☺ A few pointers:

- must have some practical significance
- if in doubt, ask TAs/instructors (do this early!)

Extra-features (mini-project) – Q&As

 can be a combination of mechanical/electronical parts

 can use any of the sensors/features on the Arduino board (does not count towards the $65)

 can be pure FW/SW implementation

Q: "Can we build a circuit on a custom PCB?"

A: It depends. Come talk to the instructors. You will still need to build a working prototype for your circuit.

Q: "How much workload should we aim for?"

A: Approximately 20% off your total course workload.

Q&As

Q: "What is a team submits a proposal, gets the 5%, but does not show anything for the mini-project at the final demo?"

A: Such a team would lose the 5% for the mini-project proposal, and of course get a 0 for the whole mini-project part.