Lesson Title: Intro to Assistive and Service Robots
Start/end times: 1 hour

Lesson Objective(s):
To learn about assistive and service robots and the role they play in healthcare.
Introduction to the project work.

Lesson Launch Notes:	**Lesson Closure Notes:**
Ask every student to come up with words that describe the jobs robots perform. Generate a Wordle and ask students what patterns they see.	The teacher will go to each group and ask them what their focus will be and what they want to find out from their senior partner.

Lesson Tasks, Problems, and Activities (attach resource sheets):
15 min – Intro to Assistive and Healthcare robots Powerpoint
15 min – Intro to the project Powerpoint
5 min – Split up into groups (count off by 3)
20 min – Gather in your project group and prepare a set of interview questions to ask seniors
Interview questions should be completed in Engineering notebook.

Evidence of Success:
Observe to see that each student is contributing to thoughtful conversation in his or her group.
Check to see each group has their set of interview questions for tomorrow's trip to the nursing home.

Notes and Nuances:
Establish to the class that they will need to use proper verbiage when talking to their senior partners. Some may not be technical engineers or scientists.

Resources:	**Homework:**
See Appendix A for presentation. http://www.wordle.net/create	Come prepared to interview your group's senior partner.

Lesson Title: Trip to the Nursing Home
Start/end times: 1 hour

Lesson Objective(s): Investigate and identify problems that seniors face in their daily activities that could be solved with robotics.	
Lesson Launch Notes: Gather into your groups and introduce each group to their senior partner.	**Lesson Closure Notes:** Groups should thank their senior partners for their time before being dismissed.
Lesson Tasks, Problems, and Activities (attach resource sheets): 50 min – Interview your senior partner and identify problems that they face in their day-to-day activities. Brainstorm some robot design concepts with them.	
Evidence of Success: Teacher will walk around and observe students interviewing their senior partner. Help out with the brainstorming session if students' momentum is slowing down.	
Notes and Nuances: Establish to the class that they will need to use proper verbiage when talking to their senior partners. Some may not be technical engineers or scientists.	
Resources: Trip to the nursing home or elderly care home.	**Homework:** Reflect on your discussion today and start thinking about robot design concepts.

Lesson Title: Project Scheduling
Start/end times: 1 hour

<table>
<tr><td colspan="2">Lesson Objective(s):
Students will learn about project scheduling.</td></tr>
<tr><td>Lesson Launch Notes:
Gather in your group and share one valuable thing you learned from your interview.</td><td>Lesson Closure Notes:
Each group must figure out a problem they want to solve.
Write in your engineering notebook the tasks your group wants to begin taking on in the next class.</td></tr>
<tr><td colspan="2">Lesson Tasks, Problems, and Activities (attach resource sheets):
20 min – Lesson on how to effectively develop a project schedule and stick to it
30 min – Students will work in their groups to identify a problem they want to solve with a robot design.
Students will also start developing their project schedule for the rest of the unit. Students will share within their group their strengths and weaknesses.</td></tr>
<tr><td colspan="2">Evidence of Success:
Observe that the group is using time wisely to develop their project schedule and identify a problem they want to solve.
Project schedules are due the day after. Groups will meet with the teacher to discuss project schedule and feasibility.</td></tr>
<tr><td colspan="2">Notes and Nuances:</td></tr>
<tr><td>Resources:
See Appendix B for presentation.</td><td>Homework:
Each student must come up with 2-3 robot designs. Please label and use brainstorming pictures to illustrate the design concept.</td></tr>
</table>

Lesson Title: Work Day to Develop Schedule and Robot Design
Start/end times: 1 hour

Lesson Objective(s):
Students will continue working in their groups to develop a schedule.
Students will also share their designs within their group and start brainstorming a robot design.

Lesson Launch Notes:
Review the class on the tasks each group should be working on:
- Developing a working schedule
- Share your designs and start narrowing down a design.

Lesson Closure Notes:
Write in your engineering notebook the tasks your group wants to begin taking on in the next class.

Lesson Tasks, Problems, and Activities (attach resource sheets):
50 min – Develop your working schedule
Share your designs within your group
Brainstorm designs and start sketching your design you want to pursue.
Identify tasks that need to be completed (building, programming, documenting, etc. and your roles)

Evidence of Success:
Teacher will walk around and check off that each student has come up with 2-3 designs in their notebook.
Observe that each group is making progress with their schedules and designs.

Notes and Nuances:
Students may want to start building their robots. They may use the robot parts to demonstrate a design concept, however if a group starts building their robot, have the teacher ask the students what their design intends to be.

Resources:
Computer/Internet – for brainstorming and research.

Homework:
Reflect on your concept designs. Come prepared to continue with work.

Lesson Title: Group Working Schedule Meeting and Work Day
Start/end times: 1 hour

<table>
<tr><td colspan="2">Lesson Objective(s):
Groups will meet individually with the teacher to go through their proposed working schedule.
Groups will continue to work on their design tasks.</td></tr>
<tr><td>Lesson Launch Notes:
Review the class on the tasks each group should be working on:
- Robot design
- Identifying tasks that will need to be completed</td><td>Lesson Closure Notes:
Write in your engineering notebook the tasks your group wants to begin taking on in the next class.</td></tr>
<tr><td colspan="2">Lesson Tasks, Problems, and Activities (attach resource sheets):
50 min - Teacher will call up each group randomly. Groups will share their proposed working schedule and roles. Teacher will provide feedback.
Groups will continue to work on their robot design and tasks.</td></tr>
<tr><td colspan="2">Evidence of Success:
During each group meeting, make sure:
- Tasks have been identified
- Calendar matches your calendar (due dates, etc.)
- Each person understands their role in the group
- Feasibility</td></tr>
<tr><td colspan="2">Notes and Nuances:</td></tr>
<tr><td>Resources:
Computer/Internet – for brainstorming and research.</td><td>Homework:
Come prepared in the next class to work on your task.</td></tr>
</table>

Lesson Title: Intro to Critical Design Review
Start/end times: 1 hour

<table>
<tr><td colspan="2">Lesson Objective(s):
Students will learn about a Critical Design Review.</td></tr>
<tr><td>Lesson Launch Notes:
Teacher will go through the project/class schedule again
- CDR date
- Final presentation date
- Expo date</td><td>Lesson Closure Notes:
Write in your engineering notebook the tasks your group wants to begin taking on in the next class.</td></tr>
<tr><td colspan="2">Lesson Tasks, Problems, and Activities (attach resource sheets):
20 min – Critical Design Review lesson Powerpoint
30 min – Continue working in your group</td></tr>
<tr><td colspan="2">Evidence of Success:
Observe that each group is making progress with their design. They should be starting to build and/or program their robots.</td></tr>
<tr><td colspan="2">Notes and Nuances:</td></tr>
<tr><td>Resources:
See Appendix C for presentation.
Computer/Internet – for research and programming</td><td>Homework:
Come prepared in the next class to work on your task.</td></tr>
</table>

Lesson Title: Programming and Sensors
Start/end times: 1 hour

<table>
<tr><td colspan="2">Lesson Objective(s):
Students will learn about advanced programming and a review of sensors.</td></tr>
<tr><td>Lesson Launch Notes:
Teacher will review with the class the overall tasks
- Programming lesson
- Continue with your robot design</td><td>Lesson Closure Notes:
Write in your engineering notebook the tasks your group wants to begin taking on in the next class.</td></tr>
<tr><td colspan="2">Lesson Tasks, Problems, and Activities (attach resource sheets):
30 min – Programming and sensor lesson Powerpoint
Go through how to create a flowchart
Go through good programming practice
20 min – Use the rest of the class to work in your groups</td></tr>
<tr><td colspan="2">Evidence of Success:
Observe that each group is making progress with their design.
They should be continuing to build and/or program their robots.
Make sure each group is sticking to their project schedule and tasks.</td></tr>
<tr><td colspan="2">Notes and Nuances:</td></tr>
<tr><td>Resources:
See Appendix D for presentation.
Computer/Internet – for research and programming</td><td>Homework:
Create a flowchart in your engineering notebook of your proposed robot program</td></tr>
</table>

Lesson Title: Work Day for next 5 classes
Start/end times: 1 hour for the next 5 classes

Lesson Objective(s):
Students will continue to work on their robot design.

Lesson Launch Notes:
Teacher will review with the class the overall tasks

- Critical Design Review date
- Make sure you are keeping up with your project schedule and make adjustments if necessary.

Lesson Closure Notes:
Write in your engineering notebook the tasks your group wants to begin taking on in the next class.
(For 3rd of 5 class): Go through what you expect in the Critical Design Review.

Lesson Tasks, Problems, and Activities (attach resource sheets):
50 min – Work in your group
Build and/or program your robot
Ask questions if you need help or advice

Evidence of Success:
(For 1st of 5 class): Check off to see if each student completed their flowchart homework
Observe that each group is making progress with their design.
They should be continuing to build and/or program their robots.
Make sure each group is sticking to their project schedule and tasks.

Notes and Nuances:

Resources:
Computer/Internet – for research and programming

Homework:
Come prepared in the next class to work on your task.

Lesson Title: Critical Design Review
Start/end times: 1 hour

<table>
<tr><td colspan="2">Lesson Objective(s):
Students will go through a Critical Design Review</td></tr>
<tr><td>Lesson Launch Notes:
Gather in your groups and prepare for your CDR</td><td>Lesson Closure Notes:
Teacher will go through the assessment items and ask class to think about a rubric that they will design together in the next class.
- Final Presentation
- Engineering notebook (one from each student)
- Visual for presentation</td></tr>
<tr><td colspan="2">Lesson Tasks, Problems, and Activities (attach resource sheets):
50 min – Each group has 7 min to go through their design, current work in progress, and tasks that still need to be completed.
For remaining 3 min, teacher will provide critical feedback.</td></tr>
<tr><td colspan="2">Evidence of Success:
Observe that each student in the group has a chance to talk and has been involved in the working progress.
Make sure each group understands their work and remaining tasks that they still need to complete.</td></tr>
<tr><td colspan="2">Notes and Nuances:</td></tr>
<tr><td>Resources:
Computer/Internet – for research and programming</td><td>Homework:
Come prepared to help design a rubric for the entire class. Research a couple of rubrics online and jot some thoughts in your engineering notebook.</td></tr>
</table>

Lesson Title: Developing a Rubric
Start/end times: 1 hour

<table>
<tr><td colspan="2">Lesson Objective(s):
Students will design a rubric as a class that will be used to assess their work.</td></tr>
<tr><td>Lesson Launch Notes:
Teacher will review with the class the assessments
- Final Presentation date
- Engineering notebooks
- Visual for the presentation</td><td>Lesson Closure Notes:
Write in your engineering notebook the tasks your group wants to begin taking on in the next class.</td></tr>
<tr><td colspan="2">Lesson Tasks, Problems, and Activities (attach resource sheets):
30 min – Teacher will put up the three categories of assessment and ask each student to come to the board to list characteristics of an excellent assessment
Narrow down to a few characteristics for each assessment
20 min – Use the rest of the class to continue your robot</td></tr>
<tr><td colspan="2">Evidence of Success:
Observe that every student helps with the collaboration effort. If some students haven't contributed, ask them to share their thoughts on the rubric.</td></tr>
<tr><td colspan="2">Notes and Nuances:</td></tr>
<tr><td>Resources:
Teacher will distribute a copy of the rubric to each student</td><td>Homework:
Come prepared to continue working on your robot.</td></tr>
</table>

Lesson Title: Work Day for next 4 classes
Start/end times: 1 hour per class period

Lesson Objective(s): Students will continue working on their robot and finalizing their project. Students will also start prepping for their final presentation.	
Lesson Launch Notes: Teacher will review with the class the assessments and take any questions. - Final Presentation date - Engineering notebooks - Visual for the presentation	**Lesson Closure Notes:** Identify what needs to be completed and what each person can accomplish at home for homework (presentation outline, powerpoint, visual, etc.)
Lesson Tasks, Problems, and Activities (attach resource sheets): 50 min - Work in your group Finalize your design Prep for your final presentation and expo	
Evidence of Success: Observe that each student in the group has a chance to talk and has been involved in the working progress. Make sure each group understands their work and remaining tasks that they still need to complete.	
Notes and Nuances:	
Resources: Computer – for programming and presentation prep	**Homework:** Students will determine their own homework

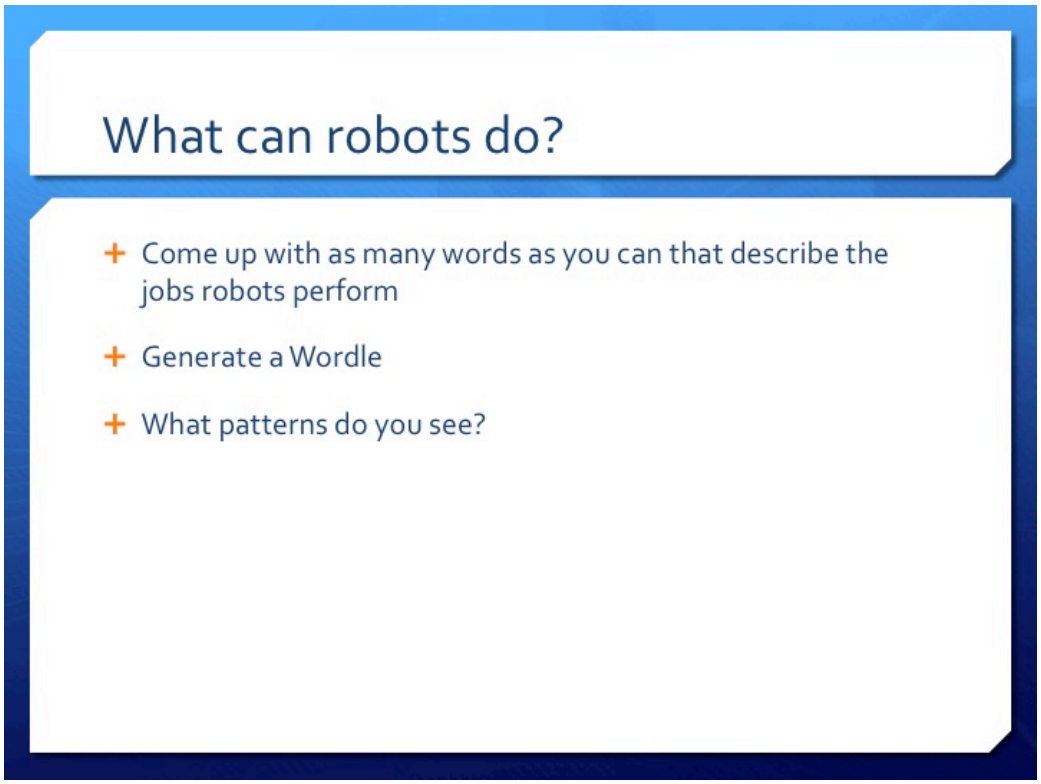
Lesson Title: Final Presentation
Start/end times: 1 hour

Lesson Objective(s): Students will be presenting and demonstrating their final robot design.	
Lesson Launch Notes: Gather in your group for last minute prep work. Have one member from your group upload their Powerpoint on the teacher's computer.	**Lesson Closure Notes:** Gather in your group to make preparations for the expo at the nursing home next class.
Lesson Tasks, Problems, and Activities (attach resource sheets): 50 min – Each group will have 7 min to present their presentation and 3 min for Q&A	
Evidence of Success: Teacher will utilize rubric to assess final presentations. Teacher will observe that each student has contributed to the presentation.	
Notes and Nuances:	
Resources:	**Homework:** Prep for next class' expo.

Lesson Title: Assistive Care Robots Expo
Start/end times: 1.5 hours

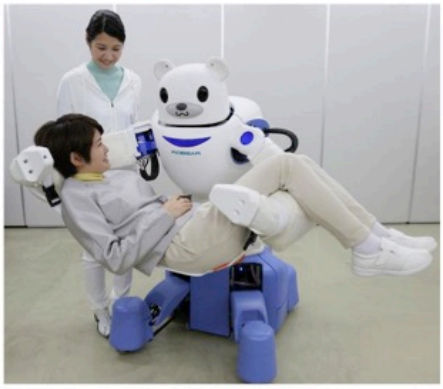
<table>
<tr><td colspan="2">Lesson Objective(s):
Students will be part of an Assistive Care Robots Expo at the community nursing home.</td></tr>
<tr><td>Lesson Launch Notes:
Students will have 20 minutes to set up their presentation table.</td><td>Lesson Closure Notes:
Teacher will ask each student to share something valuable they have learned from this project.</td></tr>
<tr><td colspan="2">Lesson Tasks, Problems, and Activities (attach resource sheets):
1 hour – Students will present their work to their senior partners and other seniors in an Expo.</td></tr>
<tr><td colspan="2">Evidence of Success:
Walk around and observe students in the expo.
Teacher may ask seniors after the unit is completed for their feedback.</td></tr>
<tr><td colspan="2">Notes and Nuances:</td></tr>
<tr><td>Resources:
Groups may use computers to demonstrate their findings, therefore may need power.</td><td>Homework:</td></tr>
</table>

Appendix A – Assistive Robots



Assistive Robots

- Designed for social and physical interaction with humans to benefit health and psychological wellbeing



Examples of Assistive Robots

- Paro
  - https://www.youtube.com/watch?v=oJq5PQZHU-I
- Keepon
  - https://www.youtube.com/watch?v=yFfwoRteVwA

In Hawaii…

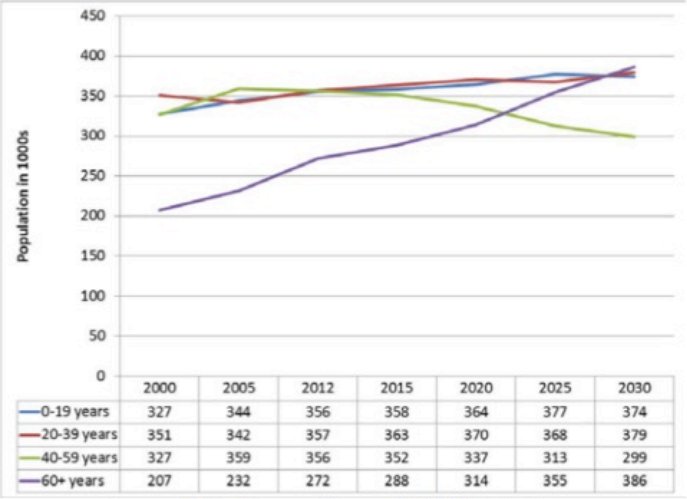
- By the year 2030, the number of people over the age of 60 will account for about 27% of Hawaii's population.
- With the demand for healthcare rising, a large number of healthcare workers are also retiring

Projected Hawaii Population

Age Group	2012	2020	2030
0 to 19	26.5%	26.3%	26.0%
20 to 39	26.6%	26.7%	26.4%
40 to 59	26.6%	24.3%	20.8%
60+	20.3%	22.7%	26.9%

Source: U.S. Census Bureau, 2009 Projections

Number of older Hawaii residents is growing (Population in 1000s)



	2000	2005	2012	2015	2020	2025	2030
0-19 years	327	344	356	358	364	377	374
20-39 years	351	342	357	363	370	368	379
40-59 years	327	359	356	352	337	313	299
60+ years	207	232	272	288	314	355	386

Source: U.S. Census Bureau, 2009 Projections

Think of someone you know who is over the age of 60…

- List out some problems they may face in their everyday lives
  - Write it out on Post-its
- Is it a social or physical type of care?
  - Stick them on the board under appropriate category
- What does a social robot do?
- What does a physical robot do?

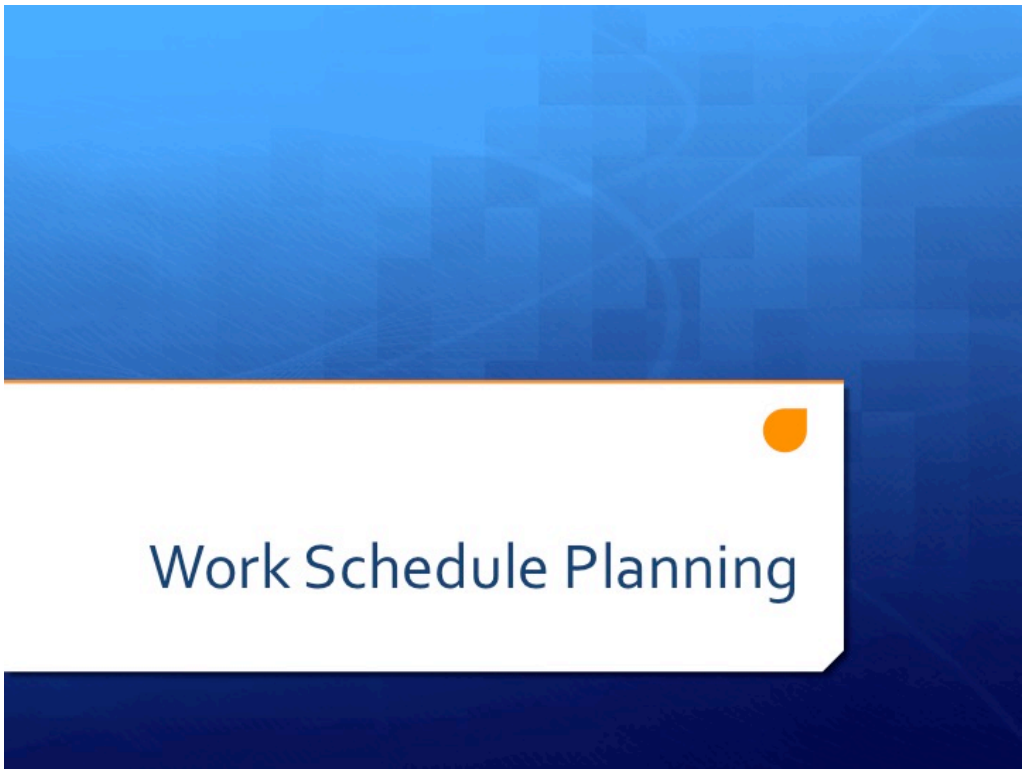
Assistive Robots Project

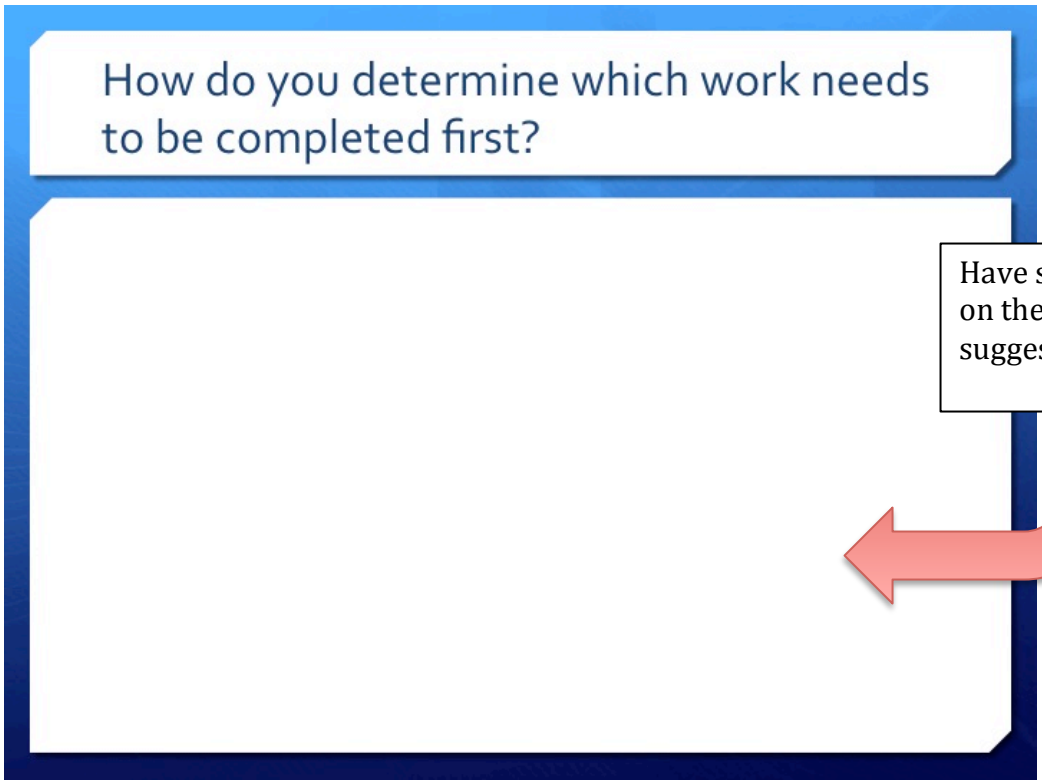
- You and your group will be going to an assisted-living home next class
- Paired with your senior partner
- Develop a set of interview questions
- Identify some problems they face in their everyday lives
- Design a robot to help their problem

Assessment

- Critical Design Review
- Final Presentation
- Visual for final presentation
- Assistive Robots Exhibition

Appendix B – Work Schedule Planning





Why do we plan working schedules?

- So this doesn't happen...

Planning a birthday party

- You want to throw your friend a birthday party
- List tasks you need to complete
  - Also state how long it will take to complete them
  - Categorize as important, flexible, not critical

- Work schedule planning with class
- Have class state tasks and write them on post its

Planning a birthday party

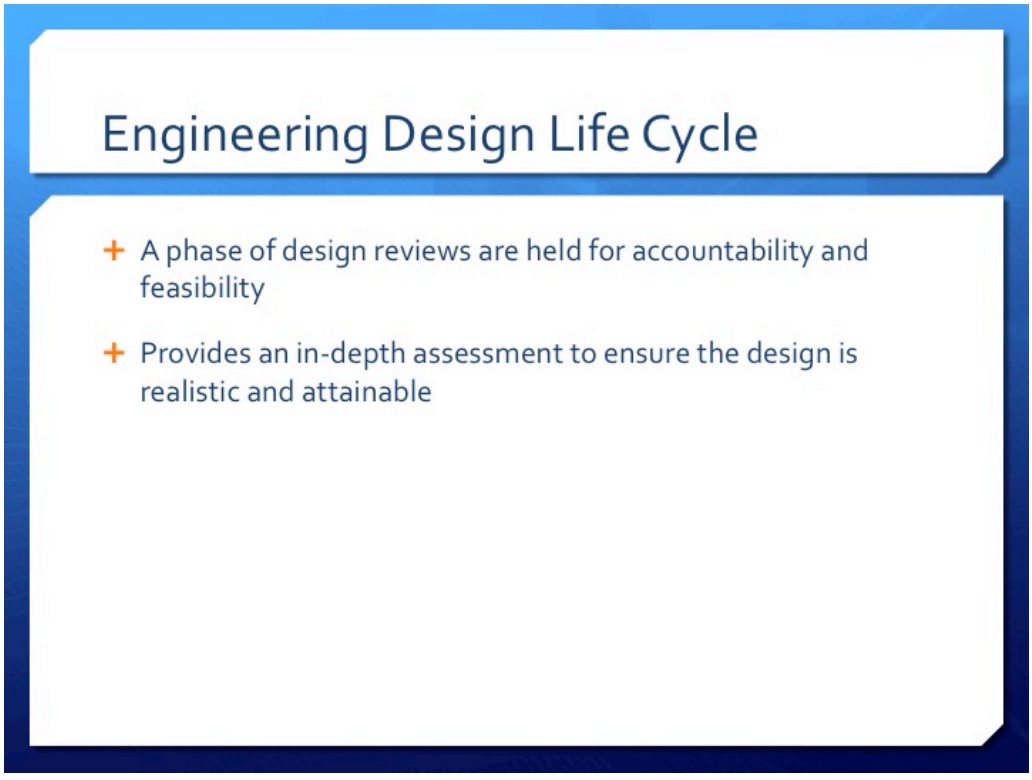
Sun	Mon	Tues	Wed	Thurs	Fri	Sat
						Birthday Party!

- Have students use post-its and stick them on board, of when tasks need to be started and completed
- What are the hard deadlines?
- When do you do the work? (after school, after dinner, weekends?)
- Who helps out with what? (roles)

Now it's your turn

- For the rest of class, complete a working schedule with your group
- What are the hard deadlines?
- What are the tasks?
- How do you split up that tasks?

Appendix C – Critical Design Review



Mission Concept Reviews

Why do we have multiple reviews?

+ So this doesn't happen…

Critical Design Review

- Demonstrates maturity of the design to proceed with full-scale fabrication
- Enough prototype testing was completed to know that everything "should" work
- To verify the final design will fulfill the specs established from mission objective

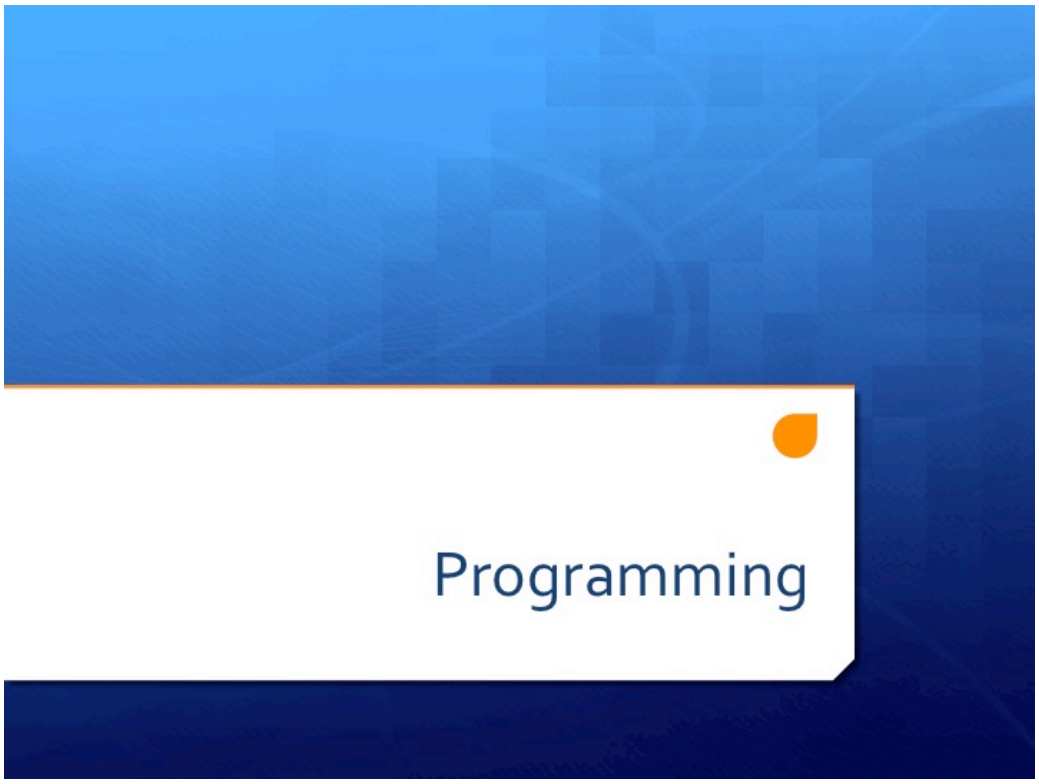
CDR Presentation Guideline

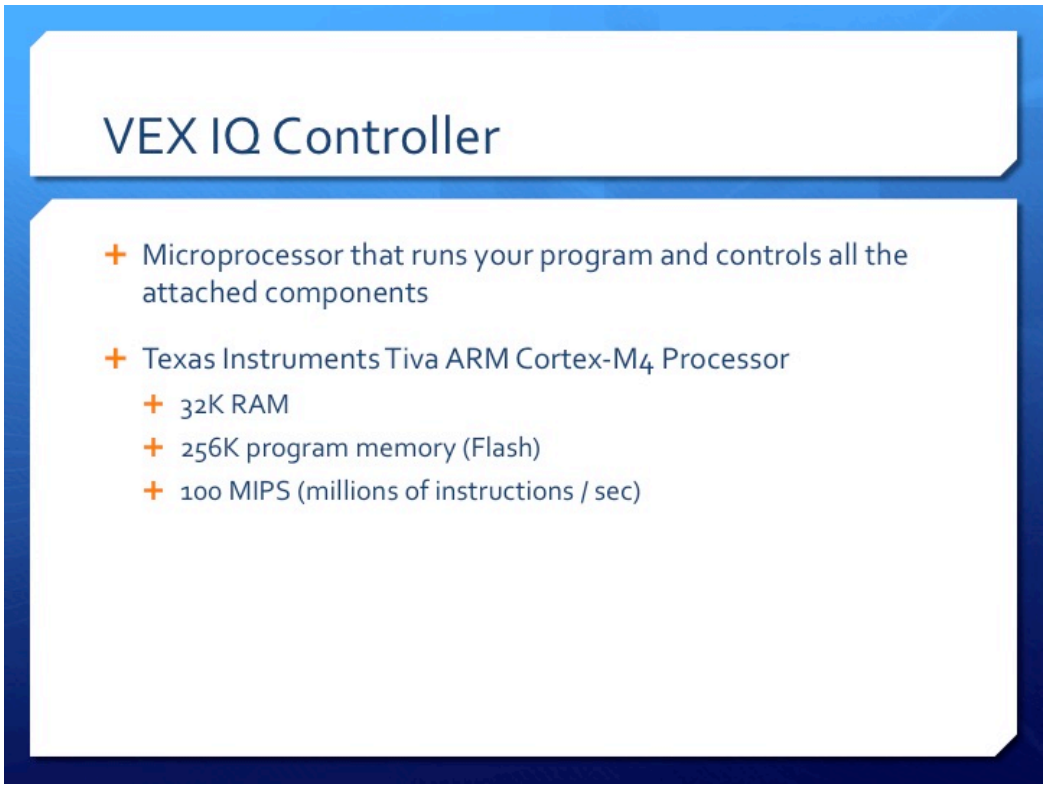
- Intro (name of product, members of group)
- Problem Statement (what is the problem you're solving and why?
- Designs considered and Challenges encountered
- Proposed Design (hardware and software)
- Current Progress
- Future Tasks and timeline of completion

CDR Presentation

- 7 minutes to present
- 3 minutes for Q&A and critical feedback
- May use a Powerpoint, video, poster, etc.
- This presentation should be about 70% close to the Final Presentation
- PRACTICE, PRACTICE, PRACTICE

Appendix D – Programming & Sensors





VEX IQ Controller

- 12 identical Smart Ports
- No dedicated input or output banks
  - Plug any VEX IQ device into any port and device is automatically detected.
- Loaded with default programs (teleop and autonomous)

Programs are like food recipes

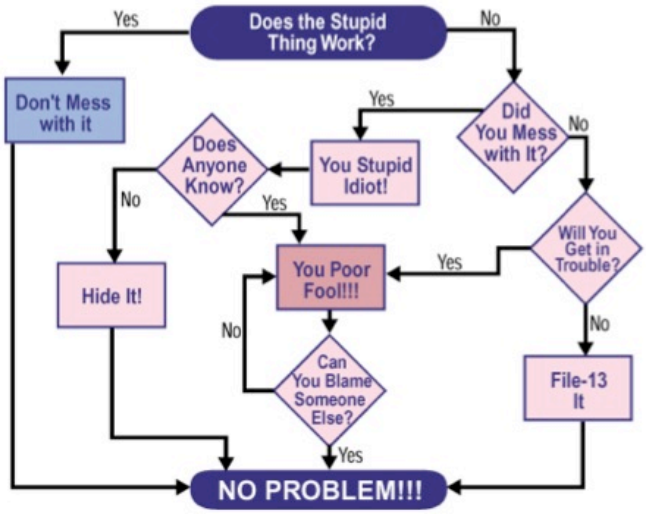
Spaghetti Carbonara
Prep: 30 min; Cook:10 min
For 4 servings

- 1 pound spaghetti
- 8 slices of bacon
- 3 eggs
- ¾ cup grated Parmesan cheese
- ½ cup half-and-half

Set a large pot of water to boil. In a large skillet, cook bacon over medium heat, stirring occasionally, until crisp, 8 to 12 minutes; transfer to a paper-towel-lined plate. Salt boiling water generously; add pasta and cook until al dente, according to package instructions. In a large bowl, whisk together eggs, parmesan, and half-and-half. Set aside. Drain pasta, leave water clinging to it. Add hot pasta to egg mixture. Add bacon; season with salt and pepper, and toss all to combine. Serve immediately, sprinkled with additional parmesan cheese.

- Recipes have:
  - Title
  - Parameter
  - Ingredients
  - Series of steps to follow

Flowchart



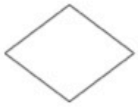
Common Flowchart Symbols

Terminator (Begin or End)

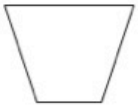
Off-page reference

Process

Manual input



Decision



Manual operation

On-page reference

Changing a Flat Tire

Functions

- Function – series of instructions to the computer to complete a task
- A function has:
  - Name
  - Zero or more parameters (e.g. number of people)
  - Zero or more declarations (e.g. ingredients)
  - Steps to complete the task

Structure of a program

- A C program consists of:
  - One or more declarations
  - One or more functions
- The function called "main" runs when the program starts

```
#pragma config(Sensor, port 3)

Task main()
{
  while(true)
  {
    setMotorSpeed(4,7);
    setMotorSpeed(5,7);
  }
}
```

ROBOTC for VEX Robotics 4.x

- For Cortex and VEX IQ robot platforms
- Can switch between
  - graphical drag-and-drop programming interface
  - Industry standard C-based programming language
- For this class, you may choose between the graphical drag-and-drop programming interface or C language

Good Programming Habits/Practices

- Keep it Simple!
- Naming conventions
  - Don't name your motors: M1, M2, etc.
  - Name them: RightMotor1, LeftMotor2, etc.
- Test your code as your write it
  - Don't write your code all at once, and test it in the end
  - Hard to find the error if you don't know where to start
- Comment, comment, COMMENT!
  - Always comment your code so it can be deciphered easily by another person

Sensors

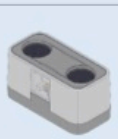
Sensors

- VEX IQ Sensors allow for autonomous and hybrid control of robots
- Connect to a robot or mechanism quickly
- Help measure time, position distance, rotation, sense touch, provide feedback, allow for human-to-robot interaction, and more.

Sensors

- Sensor – a device that detects and responds to come type of input from the physical environment
- Distance sensor – sends ultrasonic sound waves out that bounce back if something is in its path, measure distance by the amount of time it takes the sound to return
- Gyroscope – can detect and measure rotation or turning of an object
- Encoder – senses mechanical motion and translates the information (velocity, position, acceleration) into useful data.
  - VEX IQ Smart Motors have built in encoders

VEX IQ Sensors

Sensor Name	Sensor Image	Sensor Specs & Use	Default Functionality
Bumper Switch		Allows for the sense of touch in the VEX IQ platform. Detect a wall, obstacle, or limit mechanism movement.	With a Bumper Switch in port 2, it disables/enables a Smart Motor in port 4.
Touch LED		Smart Sensor with red, green, blue LEDs. Constant on, off, or blink at any desired rate. Touch sensor with finger for interaction.	Enables and disables Autopilot or similar robot running Driver Control Program when dome of sensor is tapped. Glows green when enabled, red when disabled.
Distance Sensor		Uses ultrasonic sound waves to measure distance. Measures distance from 1 inch to 10 feet. Commonly used to avoid obstacles.	Slows down and eventually stops as Autopilot or similar robot running Driver Control Program as the robot approaches an obstacle.

VEX IQ Sensors

Sensor Name	Sensor Image	Sensor Specs & Use	Default Functionality
Color Sensor		Detects the color of objects. Measures independent red, green, and blue in 256 levels each.	Enables and disables Autopilot or similar robot running Driver Control Program when the sensor is "shown" a green card (enabled) or red card (disabled).
Gyro Sensor		Measures turn rate and calculates direction. Frequently used in autonomous robot navigation and turning.	With Autopilot or similar robot running Driver Control Program, it returns a robot to its original direction when driving stops.
Smart Motor		Commands and measures speed, direction, time, revolutions and/or degrees of turn using its Encoder.	No extra default functionality, but Encoders allow for superior motor control with simple programming.

ROBOTC

+ Sensor functions are built-in in ROBOTC's function library