APSC 100

M1-W2-V1: Introduction to Design

- Engineering Design Process
  - Important model through APSC 100 and 101
- Learning goals
  - List the stages in the design process from memory
  - Describe the general flow between stages in the design process, including the role of iteration
  - Explain why a formal design process is preferred to an unstructured approach
- Design
  - Common ideas that come to mind: creativity, invention, problem-solving, innovation
  - Design is a **process**
  - Engineering design is the process through which engineering knowledge and skills are applied to solve real-world, open-ended problems
    - Meaningful problems for society, planet, and humanity
    - Open-ended means that there is not a single solution
- Novice approach
  - Implement solution with trial and error
  - Focuses on one solution at a time
  - Cost inefficient
  - Not a good approach for an engineering team, especially for a larger project
- Engineering approach
  - Systematic process = better chance of success + on time + on budget
  - Stage 0: the problem
  - Stage 1: study and clarify the problem
  - Stage 2: generate potential solutions
  - Stage 3: identify most promising solution
  - Stage 4: Develop and test solution
  - Iteration: Review and revise solution
  - Stage 5: Implement solution
  - Stages are not rigid checkpoints, and we will often revisit stages
  - The engineering design process is a guiding framework that increases chance of finding a solution
- Support for the Design Process
  - Costs: time, money, and resources
  - With the design process, fewer cost is spent on the early stages
  - Costs committed: early decisions determine spending for future stages

M1-W2-V2: Stage 1: Study and Clarify the Problem

- Stage 1: who are the stakeholders and what are their needs?
- Learning goals
    - Explain who stakeholders are and why they are important
    - Describe what needs are and where they come from
- Stakeholder
    - Anyone who is influenced by the project or anyone who can influence the project
    - Example: stakeholders of a bridge
        - Designers, builders, users, government, maintainers, neighbors, municipalities, regulators, suppliers, shareholders, manufacturers, society
    - Stakeholders have varying degrees of influence, which may sometimes be unclear
    - To minimize risks and surprises, it is important to know and understand the issues and perspectives from all of the stakeholders, right from the beginning
    - Unlikely that we will be able to satisfy everybody
- Needs
    - Things that the final design must achieve to satisfy stakeholders
    - Stakeholder's wants or expectations of what the final design should be or do
    - Expressed Needs
    - Threshold needs (needs that might not be stated but would be obvious)
    - latent needs (needs that would not be stated but would be nice to have)
- Example: smartphone
    - Stakeholders: user and government regulators
    - User needs:
        - Is affordable
        - Has front and rear cameras
        - Warns of low battery
        - is waterproof
    - Regulator needs:
        - Complies with applicable wireless communication standrads
        - Complies with applicable safety standards for consumer electronic devices
    - Observations
        - Different stakeholders tend to have different needs
            - We should consider all stakeholders and have a good sense of stakeholder needs
        - Not all stakeholders think alike
            - Stakeholders from the same group may have differing or contradictory needs
        - Some needs might be expected without saying or so "obvious" that nobody thinks to mention them
            - Important not to miss obvious needs

Learning-V3-Neuroscience

- Analogy: Olympic swimmer

    - They would not be cramming practice two days before the race
    - Thoughtfully arranged challenges going back for a long time
    - Learning is the same. Many students try to compress learning into cram sessions, which doesn't work
- Learning goals
    - Describe what happens in your brain when you learn, using the language of neuroscience
    - Explain why it is important to spread learning out over time, and why this is supported by neuroscience
    - Explain how neuroscience supports the deliberate practice approach to learning
- How the brain works
    - 100 billion neurons in the brain
    - Electrochemical signals are received by dendrites, cell body processes signals, signals travel to axon and are sent to other dendrites through axon terminals
    - A single neuron can have thousands of dendrites. The total number of connections is unimaginable
    - Neuroplasticity: neural connections can be changed and the brain can be reprogrammed
    - Effort and challenge batter: brain grows more connections, connections get stronger and more efficient for deeper and longer lasting learning
    - Knowledge is stored through the connections between neurons
    - A robust netowrk of neurons is better for recalling information
    - Unused neural connections weaken over time
    - Analogy: forest path
        - Paths will overgrow and disappear if we don't use it. Then we cannot retrieve information
        - Frequently traveling the path will make it larger
        - Multiple paths create a robust network
- Effective learning
    - More review is better
    - Quizzing (reviewing correct answers) gives the best results
    - Recap: using deep learning techniques that require retrieving and applying information is more effective than rereading and reviewing
- Why cramming doesn't work
    - Myelin: 20 percent of the brain. Coating on parts of the neurons
    - Myelin increases strength and speed of neural signals
    - Myelin makes recall quicker and more automatic
    - Myelin coating is developed over time, due to repeated activity of the neuron. Sleep plays a role in this process too
    - Developing myelin coating cannot be rushed, and learning cannot be rushed
- Effective learning based on understanding of myelin
    - Periods of high intensity learning
    - Breaks and time to relax
    - Repeated and more challenging practice

    - Full nights of sleep
- Effectiveness of deliberate practice
    - Challenge develops strong network
    - Focus: high intensity of learning for short period
    - Feedback corrects neural connections and helps long term retention
    - Refine: reflect over time

M1-W3-V1: Stage 2: Generating Potential Solutions (Conceptualization)

- Learning goals
    - Describe the goals of the Generate Potential Solutions stage of the design process
    - List the guidelines for effective concept generation and explain why each is important
    - Describe the C-sketch process for concept generation
- Goal of stage 2:
    - Generate as many potential solutions to our design problem as possible
- Generating ideas
    - When generating ideas, as time goes on, we get more ideas with greater variety. This is the solution space. The more ideas, the better
    - We can't rely on first impressions for evaluating ideas
    - The more variety the better
    - Common mistakes
        - Stopping the solution generation too early
        - When to stop? depends on how good we feel the ideas are, and whether they have a good chance of solving the problem. How much time, how routine the problem is, how quickly we're coming up with new ideas
        - Didn't challenge ourselves with novel ideas. "Fixation" or "Anchoring". Getting stuck on one idea
- Solution generation guidelines
    - Generate as many unique ideas as possible
        - Focus on quantity not quality
        - Welcome creative, unusual, and "wild" ideas
    - Resist the temptation to start developing your first idea or favorite idea
        - Avoid fixation (anchoring)
    - Do not evaluate ideas yet - that will come later
        - Focus on what will make ideas work
    - Generate a variety of ideas
        - Work independently and in a team
        - Sketch, discuss, tinker
- C-Sketch
    - Collaborative sketching
    - The team gathers, each person with their own paper

    - Team clarifies the problem
    - Each person sketches a solution. No talking, no writing or words, not about creating works of art
    - Everyone passes their sketch to the person next to them (after ~3 minutes). And then they modify the sketch (add or erase)
    - Process continues until everyone has seen and contributed to every sketch
    - Benefit: everyone gets equal time and input to each idea (as opposed to traditional brainstorming)
    - The team reviews and discusses the collaborative sketches. Can engage in another round (challenge each other to come up with completely different ideas)

M1-W3-V2: Stage 3: Identifying Most Promising Solution

- Learning goals
    - Describe the goals and steps in Stage 3 of the design process
    - Define screening, ranking, and scoring, and explain how they are used in this stage of the process
    - Describe how requirements and evaluation criteria from the target design specifications in Stage 1 are used in Stage 3
- Goal of stage 3:
    - Narrow down all possible solutions to our design problem, and identify the solution to be developed
    - After solution generation, all ideas could be the winner
    - Objective and systematic process of identifying best idea
- Requirements: the limits of acceptability for a design (from back in stage 1)
    - Screening: solutions that don't meet requirements should be removed immediately
- Evaluation criteria: measures that distinguish between levels of performance or stakeholder satisfaction (i.e. lower price is better)
    - Ranking: sort remaining potential solutions by approximate highest to lowest performance
        - Quick process
    - Scoring: for ideas that have potential, analyze
        - Build prototypes, run detailed analyses
        - Too many ideas is too much work, but we can't have too few ideas either
        - Can use tools such as WDM
    - Selection: select the best idea
- Summary
    - Screening
        - Compare to requirements and eliminate ideas that cannot meet requirements
    - Ranking
        - Roughly rank from strong to weak. Look for consistently strong ideas
    - Scoring
        - Quantify relative performance. Tool coming in Module 2 (WDM)

- Methods for ranking
    - Individual voting
        - Only works if everyone has a good understanding of problem, concepts, and evaluation criteria
        - Each person gets x number of votes for all concepts
        - Team totals vote
    - Borda count
        - Ranking top x out of y
        - Top z advance
    - Pairwise comparison
        - Comparing each concept against each other concept
        - Top x advance
    - Criterion-based ranking
        - Ranking based on performance of each concept in each criterion
        - Top x advance
- Iterative
    - We if we feel that we need to rerank ideas, we can come back to this stage

Learning-V4-Memory

- Recap
    - Learning is based on creating stronger neural connections
    - Analogy of forest path
    - No shortcuts, requires high intensity effort, relax, repeated more challenging practice, and sleep
- Learning Goals
    - Explain how short- and long-term memory work
    - Distinguish between learning tasks appropriate for short- and long-term memory
    - Describe what is meant by the "forgetting curve" and the "distributed practice" approach
    - Apply effective study strategies towards your learning, and explain the neurological basis of why they work
- Memory
    - Information is stored in short-term memory or is forgotten
    - Maintenance (for instance, repeating) is used to keep information in short-term memory
    - Organizing is used to keep information in long-term memory for retrieval in the future
- Short-term and long-term memory
    - Limited. 15-30 seconds. 5-9 items.
    - Trying to maintain short-term memory is ineffective
    - Transferring to long-term memory is more successful
- Forgetting curve
    - We forget quickly
- Distributed practice
    - After one day, a short review improves long term retention

    - More days later, a shorter review improves long term retention even more
- Study strategies
    - Strategy 1: emphasize organization, not maintenance
    - Strategy 2: connect new information to what you already know
        - For example, concept map
    - Strategy 3: pace your learning. Distributed and deliberate practice
    - Strategy 4: use retrieval

M1-W4-V1-Prototypes

- Learning goals
    - Describe what prototypes are
    - Explain why prototypes are used in design
    - Describe where in the design process prototypes are used
- Ojex Juicer prototypes. Juice extracter
    - Starting with drawing
    - 2D plastic for testing mechanical
    - 3D foam models
    - Functioning 3D prototypes
    - Strainer models
    - CAD models
- Classifying prototypes
    - Focused <-> Comprehensive
    - Virtual <-> Physical
- Cost curve revisited
    - Can be thought of as cost of an error at stage in project
    - Quick, inexpensive, simple prototypes are used in early stages. Explore, suggest, question, provoke
    - Detailed and accurate prototypes are used later Refine, describe, answer, resolve
- Purpose of prototypes: reduce risk in the design process

M1-W4-V2-Audience Purpose Context

- Learning goals
    - Describe what are meant by "audience," "purpose," and "context," in communication
    - List some of the factors related to audience, purpose, and context to consider when preparing a presentation
- Audience
    - Who you are presenting to
    - Important to understand your audience. What they already know, what they need to know, and what they do not know?
    - Audiences opinion about your topic?
    - What they hope to get from your presentation?
    - Audiences in APSC 100 & 101: imagined

- Purpose
    - Goal and reason for presentation
    - Helpful for decisions about what information to convey and how to convey it
    - Inform and persuade
- Context
    - What led to developing the presentation?
    - What is the setting?
    - When, what, where?
    - Contexts in APSC 100 & 101: poster and oral presentations

Learning-V5-Focus

- Recap
    - Learning is based on creating strong neural connections
    - Model of memory. Information -> short term memory -> long-term memory
    - Achievement = talent x effort^2. Deliberate practice and bloom's taxonomy
- Learning Goals
    - Describe the impacts of distraction on your learning
    - Explain why trying to multitask hinders learning for most people
    - Explain what is meant by "interleaving," and why it is effective for learning
    - Apply effective study strategies towards your learning, and explain the neurological bases of why they work
- The myth about multitasking
    - Only about 2% of people can multitask
    - Music reduces ability to focus during challenging tasks
    - 30-60 minute blocks on one topic. Don't jump back and forth
    - Digital devices are very distracting. -1 letter grade on final
    - Other people using devices is even more distracting. "Digital second hand smoke". -2 letter grades on final
- Strategies
    - Strategy 1: Minimize distractions
    - Strategy 2: Focus on one subject at a time in short, high intensity sections. Take a break before the next subject
    - Strategy 3: "Interleave" subjects when studying. Alternating between subjects is more effective. Study each subject for at least 30 mintues
    - Strategy 4: Effort and challenge improve learning

M2-W5-V1: Module 2 Case Study Introduction

- Prepare recommendation about transportation planning in Vancouver
- Learning goals
    - Apply a systematic and defensible approach in the decision-making process, integrating all dimensions of sustainability
    - Describe the importance of the consultation process in engineering projects

    - Effectively justify and communicate your decisions through a formal oral presentation
    - Other
        - Appreciate the complexity and importance of the stakeholder engagement and decision making processes
        - Develop a tolerance for ambiguity in engineering problems
- Context
    - Team of engineers working for City of Vancouver
        - Develop recommendation of next protected bicycle lane for the city
    - Personal vehicles dominate streets of most large cities.
        - Inefficient form of transportation.
            - /km travel is very high cost. Consume lots of energy. Negative environmental impact. Take up lots of space
        - Part of issue is in vehicles, part of issue is in roads
    - Despite different fuel sources, all vehicles still have large environmental impact
    - Still consume too much space and materials for the function they serve
    - Public transit is much more efficient. Still requires lots of money and space
    - Adding nature and greenspaces improves wellbeing. Improves trust, desire to return, happiness.
    - Walking and transportation also improve wellbeing.
    - Transportation 2040
        - manage traffic to improve safety and neighborhood livability
        - Build cycling routes that feel comfortable for people of all ages and abilities
        - upgrade and expand the yccling network to efficnetly connect people to destinations
- Cycling on streets
    - Perceived unsafe.
    - Protected cycle lane is best. Safest and most comfortable experience for cycling. AAA designation: all ages and abilities
        - Safety. away from traffic
        - Comfort. room to pass, smooth surfaces, good lighting
        - Convenience: good connections on the network, limited grade
        - Cycle lanes also benefit pedestrians
- Economic impacts
    - Cyclists tend to have more disposable income. Also more likely to stop at local businesses, which improves economic
    - Downtown Vancouver Business improvement Association endorses protected cycling lanes. Active funder and partner for more protected cycling lanes.
        - Attracts more highly skilled workers, higher paying jobs, retail spending
    - Burrard Bridge. 1 lane -> cycling. People thought there would be issues, but it was great
- Project
    - Create a plan. Consider all stakeholders. Convince the city and the public.

M2-W5-V2: Scales

- Learning goals
    - Describe the concept of scale
    - Describe the effect of scale on our view of engineering problems, on the pool of relevant stakeholders, and on potential solutions
    - Recognize that, as engineers, we need to view problems at different scales
- Engineering a car: different systems.
    - Car and driver. At a large scale, car and driver share the road
    - Larger system: car and city. Involving other vehicles and people. Design of buildings, infrastructure.
    - On region scale: effects on commute time, traffic infrastructure, law enforcement and regional air quality.
    - Larger scale: environmental impact, energy supply, manufacturing
    - Interdependence on other systems: legal, regulatory, political, economic, etc.
- Pothole in the road:
    - Solution? improve materials. Better wheels. Systems to improve comfort - suspensions? or maybe it's about construction of roads. Regional policy related to maintenance. Best solution: alternate transportation in the long term?
    - Different solutions appear at different scales. Also important to understand that the best solution might not be at a technical one. We need to understand the problem by viewing it across many scales.

M2-W5-V3: Salience

- Example: Site C Dam
    - Benefits
        - Provides renewable electrical power for over 100 years
        - Enough power for 500,000 homes. Important piece of infrastructure for everyone.
        - Construction will require a huge workforce - 13000 person years. Benefits economy of Fort St. John, especially during
        - Funding for social program, and other groups
    - Drawbacks
        - The reservoir takes away water and land uses. Affects hunting and fishing grounds of various first nations, destroys indigenous burial sites and other sites of cultural significance.
        - Farmers and ranchers are impacted by flooding.
        - Impact to air, water, and land systems. Environmental impacts
    - Opposition
        - Numerous protests and rallies opposing the project. Protests from the river to Vancouver.
        - Conflicting stakeholders
- Learning goals
    - Describe the concept of stakeholder salience in terms of power, urgency, and legitimacy

    - Describe how salience is used in prioritizing stakeholders through a project
    - Differentiate a rights holder from a stakeholder, and explain why this distinction is important
- Stakeholder
    - Anyone who is influenced by or can influence a project
- Salience: how prominent and important they are in a project.
    - Power
        - How much a stakeholder can influence the project.
    - Urgency
        - How important or time-sensitive the project is to stakeholder needs
    - Legitimacy
        - Has a right to have a say in the project. Could be legal or moral right
    - Primary stakeholders: have all three attributes are the and are prioritized
    - Secondary stakeholders: two attributes
    - Tertiary stakeholders: one attribute
- Rights holder: a stakeholder whose legal rights or human rights could be impacted by a project.
    - For Indigenous groups, rights holder is preferred to stakeholder
- Challenges with the framework
    - There may be different degrees to the amount of power each stakeholder has in each attribute
    - Stakeholder Salience is dynamic - important to continuously monitor stakeholders. Will reduce surprises
- Engagement strategies
    - Inform all stakeholders of project
    - Give primary and secondary stakeholders opportunity to provide input. Sometimes consider tertiary
    - Primary stakeholders are involved during decision making. Sometimes consider secondary
    - Sometimes consider collaborating with primary stakeholders

Learning-V6-HealthyBody

- Exercise helps brain
    - Chemicals
        - Brain-derived Neurotrophic Factor (BDNF)
        - Serotonin
        - Dopamine
        - Norepinephrine
    - Aerobic activity is the best
- Diet also helps brain
    - Good foods
        - Omega-3: salmon, tree nuts (especially walnuts)
        - Antioxidants: blueberries, olive oil, beans, dark chocolate

        - Balanced diet with abundance of vegetables
    - Bad foods (consume in moderation)
        - Heavily processed food
        - Unhealthy snacks
        - Deep-fried foods
        - Sugary snacks and drink
        - Anything in a vending machine
    - Brain requires lots of energy, food fuels the brain
    - Breakfast: a nutritious breakfast is important
- Sleep
    - Consolidate and reinforce learning
    - We dream during REM
    - Brain consolidates learning in NREM
    - During REM sleep, signals travel backwards, from axon to dendrites
        - Clearing up junk
    - Insufficient sleep
        - Makes it harder to pay attention
        - Impedes BDNF
        - Impedes retrieval
    - We should get between 7.5 and 9 hours of sleep
    - 20 minute naps are good during the day

M2-W6-V1: An Introduction to Sustainability

- Learning goals
    - Define sustainability
    - list the dimensions and principles of sustainability
    - Describe how the dimensions interact, and what is meant by a sustainable solution
- Common view
    - Sustainability is associated with protecting and preserving the natural environment
- Definition of sustainability
    - Meet the needs of the present, without compromising the future
- Importance in design
    - Sustainability is an integral part of the entire design process
- Dimensions of sustainability
    - Dimensions
        - Society (People) (Equity)
        - Environment (Planet) (Ecology)
        - Economy (Profit) (Economy)
    - Bearable: environment + society
    - Viable: environment + economy

    - Equitable: society + economy
    - Goal: find solutions that work in all three dimensions
    - Context is important
- Four principles in a sustainable society:
    - Avoid removing materials from the earth at a rate faster than they naturally replenish
    - Avoid making things and releasing substances at a rate faster than they naturally break down
    - Avoid degrading ecosystems at a rate faster than they can naturally regrow
    - Move towards happiness, well-being, and meeting the needs of all people
- 17 UN Goals of sustainability

M2-W6-V2: Causal Loop Diagrams

- Learning goals
    - Recognize that we need different (qualitative) tools to analyze complex systems, compared to the traditional (quantitative) tools used with simple systems
    - Describe what a causal loop diagram is and how it is used
    - Interpret a simple causal loop diagram
- Complex vs complicated system. Deterministic vs non-deterministic
- To analyze complex systems, we need to use qualitative methods, such as causal loop diagrgams
- Causal loop diagram
    - Nodes
    - Relations (positive or negative)
    - Double line on connecting link: delay
    - Reinforcing loop: increases and keeps increasing
    - Balancing loop: increases then decreases
- Net product positive: positively correlated
- Net product negative: negatively correlated

M2-W6-V3: Engineering Profession

- Learning goals
    - Describe what a profession is
    - Describe how engineering is regulated in Canada, and how an engineering student can go on to become an engineer
    - Describe what "Codes of Ethics" are and why they are important
    - Describe the significance of the Iron Pin and the Iron Ring to engineers in Canada
- What is a profession
    - A group of individuals, widely recognized by the public, who:
        - Possess specialized knowledge or skills,
        - Have received specialized training or education
        - Adhere to ehtical standards and
        - Apply their knowledge and skills in the interest of others
    - Regulation (often self regulated)

        - Engineers Canada
        - Engineers and geoscientists BC
- Code of ethics
- Engineering titles
    - Engineering student -> engineering graduate -> engineering in training -> professional engineer
- Professional Engineer seal
- Iron ring (little finger of writing hand): symbol of pride for engineers. Received upon graduation
- Iron pin: engineering student
- UBC Engineering Code of Ethics

Learning-V7-Stress

- Learning goals
    - Define "stress," "stressor," and "anxiety"
    - Describe the relationship between stress and performance, and appreciate that some stress is good
    - Describe the biological basis of stress
    - Identify and employ practical stress management strategies
    - Explain the difference between "mental health problem" and "mental illness," and identify resources when extra help is needed
- Definitions
    - Stressor: an activity, event, or something that causes stress
    - Stress: a reaction to a stressor happening now and triggered by a specific situation
    - Anxiety: fear or worry about something that may or may not happen in the future, out of proportion with the actual likelihood or impact; the stress that continues after a stressor is gone
- Characterizing stress
    - Low stress -> low performance
    - Optimal stress -> peak performance. Motivated, focused, energized
    - Over stress -> fatigued exhausted
    - Burnout -> low performance. panic, anger, breakdown
- Stress: evolutionary adaptation to save life. Fight-or-flight response
    - Release of stress hormones such as adrenaline (burst of energy) and cortisol (influences emotions)
- Everyday stress
    - Stress response is a good thing, indicates that the brain realizes there is something to take on
        - Rapid breathing & heart pounding: more oxygen for brain
        - Body pausing digestion
        - Tension or sweating: body is getting ready to perform
    - Stress responses are helpful to keep us motivated
    - Become problematic if we are always in high stress

        - Impaired brain, function, attention and mood
        - High blood pressure
        - Chest pain, muscle pain, and fatigue
        - Upset stomach, hunger, impact on digestion
        - Loss in muscle tissue and bone density
- Strategies to Promote mental Health
    - Take occasional mental breaks. Activities such as relaxing, personal time, socialize, hangout, help others, mind-body practices, exercise
    - Exercise: releases serotonin, dopamine, and norepinephrine. Releases endorphins. Reduces cortisol and adrenaline
        - 30 minutes of aerobic exercise 4-5 times a week is ideal
    - Laughter: socialize. Produces serotonin, dopamine, endorphins. Also releases oxytocin. Reduces stress hormones
    - Helping others: Releases serotonin, dopamine, oxytocin.
    - Mindfulness: activities like yoga, meditation. Releases serotonin and dopamine, melatonin, reduce cortisol
    - Sleeping: 7.5 to 9 hours a day.
    - Eating right: vitamins B, C, D. Vegetables, fruit, milk and yogurt. Omega 3.
- When to get help
    - When stress is too high
- Mental health problem vs Mental Illness
    - Mental health problem: a substantial emotional, thought, or behavioral difficulty that causes you significant life challenges. Usually requires help from friends, family, and people you trust
    - Mental illness: when a person is unable to function in their everyday life due to the way their brain is controlling their thoughts, emotions, and behaviors. Diagnosed and trained by professionals.
- 5 step approach: reframe the stress response -> identify the source f your stress response -> make a plan -> apply your solutions to the problem -> evaluate the success of your solutions

M2-W7-V1: Weighted Decision Matrix

- Learning Goals
    - Describe what a weighted decision matrix (WDM) is and how to construct one
    - Describe where the values in a WDM come from and what they mean
    - Explain when a WDM might be used in an engineering project
- Weighted Decision Matrix
    - Weights should reflect priorities of stakeholders, not team
    - Not all specific requirements are required? (from quiz)
- Sensitivity of results
    - Desirably, slight changes to weight gives the same rank
    - An option that frequently ranks low can be eliminated

M2-W7-V2: Presentations

- Learning Goals
  - Explain how the organization and structure of a technical presentation impacts presentation effectiveness
  - Describe the key principles of the Assertion-Evidence method for slide construction
  - Outline the qualities of effective and ineffective visual aids in a technical presentation
- Tips
  - Logical organization
  - Clear, descriptive, and non-excessive outline
  - Textblocks
    - No grammatical errors, contractions, super long sentences
    - Spell out words
    - Summarized in short bullets, not word for word
    - DO NOT DIRECTLY READ SLIDE TEXT
  - Slide title that reflects content
  - Visual aids that are helpful, not just for decoration
    - Do not have generic graphics
  - Assertion-Evidence
    - More likely to pique audience's interest
    - Alternative to bullet point list
  - Slide background
    - Ideally background that is not distracting, and must not impede reading text (good contrast)
    - Built-in themes should not be used without thought
  - Transitions and animations
    - Just because they can be used doesn't mean you should
    - Not appropriate for technical presentation

Learning-V8-Metacognition

- Higher metacognitive awareness -> higher grades
- Learning goals
  - Define metacognition and describe it in terms of knowledge of cognition and regulation of cognition
  - Relate metacognition to the learning practices introduced in the Transitioning to University Learning screencast series
  - Explain the steps in the Deliberate Practice process in terms of metacognition
  - Define and identify "stretch goals" and the "fluency bias"
- Metacognition
  - Cognition: thinking proecsses
  - Meta: beyond
  - Awareness, understanding, and control of your thinking and learning processes

    - Thinking about thinking
- Knowledge of cognition: What we know about thinking
    - Principles of how learning work: "what"
    - Effective learning strategies: "how"
    - When to apply these strategies: "when"
- Regulation of cognition: How we use our knowledge about thinking
    - Planning for learning -> managing information -> monitoring learning -> correcting for errors -> evaluating learning
- Deliberate practice
    1. Challenge: set a stretch goal (detailed, specific goal just out of reach but we can achieve by challenging ourselves)
    2. Focus: high intensity, short time
    3. Feedback: monitor your learning
    4. Refine: reflect and repeat
- Fluency bias
    - Do easy things we are good at

M2-W8-V1: Delivering Technical Presentations

- Learning Goals
    - Describe the role of voice and body language in effective delivery of oral presentations
    - Describe the factors influencing the professionalism of a presentation, and the impact they have
    - Explain how language choices enhance or detract from a presentation
- Delivery: conveying idea through voice and body language
    - Don't be monotonous spend most of the time looking at notes
    - Nervous body language: don't have distracting body movement. Don't focus on ground and ceiling
    - Use gestures, but don't overexaggerate gestures. (depends on scale of audience. Larger gestures for larger audience)
- Professionalism
    - Attentiveness, enthusiasm (technical presentation does not have to be stuffy)
    - Attire (smart casual attire). At least more dressed than audience. For us, smart casual or business.
- Language: speak clearly with compelling language choices that support the presentation and are appropriate for the audience
    - Language choices appropriate for audience.
    - Avoid excessively long, complex sentences.
    - Formal, precise language. Avoid um, ah, you know. If you get stumped, pause, breathe, collect your thoughts.

Learning-V9-Summary

- Basically, just learn effectively. Metacognition

M3-W9-V1: Eric Rea

- Quadriplegic video game designer
- Adaptive device: tool that allows you to bridge the gap between your disability and whatever it is you are trying to physically interface with
    - Ex. strap for fork
- 3D printer: convert idea into design in physical form
    - Suitable for small parts produced in small numbers
- CAD and 3D printing allows Eric to visualize his designs
    - Allows for designs that give allow users to experience the fun in life, as opposed to standard adaptive evices

M3-W9-V2: Ken Fraser

- Ken Fraser
    - Executive director of Vancouver Resource Society
    - Accident in 1979
        - Broke his neck. Break at C5-6 while diving in a swimming pool
    - Results
        - Paralyzed from armpits down
        - Limited hand function
        - Limited arm movement (Bottom half of arm is also paralyzed)
- Ken's adaptive devices
    - Typing splint. Can be used a a pen, or reversed to use for typing
        - Elastic bands for improved grip with friction when writing
        - Held by position of the hand
    - For faster typing, uses a splint in his right hand and left pinky on his left hand.
- Range of movement
    - Arms barely above shoulder
    - Extended forward but quite curved
    - Extend outwards a reasonable amount
    - Pinky is curved tightly (muscle tightness). Provides strong grip for pen stability
- Challenging tasks
    - Paperwork
        - Pushing around, sliding around, flipping page. Glove friction
    - Eating
        - Eats by himself. Eats corn on the cob by stabbing it with a fork, and then holding it up to his mouth

M3-W9-V3: Stress and Strength

- Learning goals

    - Define stress, strength, elastic deformation, plastic deformation
    - Describe the difference between ultimate tensile strength and yield strength
    - Calculate stress for a simple component loaded in tension
    - Explain how to avoid yield and breaking failures for simple engineering components
- Stress
    - sigma = stress = Force/Area. Also called pressure in some contexts
    - Unit N/m^2 = Pa
- Fracture (breaking) failure
    - Cause
        - Stress > strength
        - sigma > sigma_ut (ultimate tensile strength of material)
    - To avoid:
        - Ensure sigma <= sigma_ut
        - Smaller force, thicker cable, or material with higher ultimate tensile strength
- Yield failure
    - Elastic deformation
        - Temporary change in shape
    - Plastic deformation (yield)
        - Permanent change in shape
    - Cause
        - Stress > yield strength
        - sigma > sigma_y (yield strength of material). Note that yield strength is less than ultimate tensile strength
    - To avoid:
        - Ensure sigma <= sigma_y
        - Smaller force, thicker cable, or material with higher yield strength
- Narrower part will have higher stress for same load. Keep this in consideration for Module 3

M3-W10-V1: Ethics

- Ethics: the study of standards of right and wrong
- Dilemma: a difficult decision where no alternative is clearly preferable
- Learning goals
    - Define the terms ethics and dilemma
    - Explain how the law and the Code of Ethics can assist in resolving dilemmas
    - Describe how personal, organizational, and societal values confound resolving dilemmas
    - Apply the APSC 100 Ethics Framework for resolving dilemmas
- APSC 100 Ethics Framework
    - Choose a legal alternative. It might be a fuzzy line between legal and illegal
    - Engineering code of ethics: within law. It might be a fuzzy boundary too.
    - Personal values
    - When faced with dilemma, we should look for decision that agrees with Law, Engineering code of ethics, and personal values

    - Also consider organizational values and societal values

M3-W10-V2: Ethical Dilemmas

- Learning goals
    - Describe how risk relates to the APSC 100 ethics framework
    - Define the term "conflict of interest"
    - Describe and apply common ethical theories, including Duty Ethics, Rights Ethics, and Utilitarianism
    - Describe and apply a procedure for resolving ethical conflicts
    - Apply the concept of gradual escalation
- Ethical framework
    - Best to be well within the boundaries of ethics boundary. Actions should be clearly ethical
    - Remove any doubt of unethical behavior
- Conflict of interest
    - Potential to personally receive benefit when carrying out duty (e.g. small gift or expensive trips)
    - Avoid conflict of interest. Disclose it to others
- Addressing ethical problems
    - Can be approached similar to the design process
    - In the case where options are equal, select the option that has the least benefit to oneself. That way it is clear there is no conflict of interest
- Ethical theories
    - Utilitarianism
        - Ethically correct action produces the greatest benefit for the greatest number of people
    - Duty-Based Ethics
        - Ethically correct action follows universal principles that everyone should follow
    - Right-Based Ethics
        - Ethically correct action is one that respects other peoples' rights
- Gradual escalation
    - Identify small, low risk action first. If this does not work, progressively larger steps are taken

M3-W11-V1: Rapid Prototyping

- Learning Goals
    - Explain how rapid prototyping technologies are used in the design process
    - Describe how each of the following rapid prototyping technologies work, as well as the associated strengths and weaknesses:
        - Waterjet cutter, laser cutter, 3D-printer
- Iterating in design: sketch -> CAD model -> rapid prototype
    - Quickly moving from virtual to physical models
- Rapid prototype vs conventional machining

    - Rapid prototyping: less time consuming, does not require manual labor and skill for operating machine
- Waterjet cutter
    - Capable of cutting through almost anything using high pressure water that acts like liquid sandpaper
        - Can cut through metal, glass, ceramics, concrete, plastics, wood, composites
    - Uses either high pressure water or water + abrasive
    - Downside
        - For most waterjets, the nozzle is vertical, so it can only be used for cutting flat, 2D shapes
            - It is possible to build up complex shapes from a series of 2D parts
            - Some sophisticated waterjets can change angle of nozzle, to cut slanted
        - Impossible to control the depth of cutting (cuts right through)
        - Materials will get wet
- Laser cutter
    - Laser follows cutting path determined by computer
    - Cut with accuracy. The type of material it can cut depends on the laser cutter
    - Power can be adjusted for moderate control over cutting depth
    - Limitations
        - Most laser cutters can only cut 2D shapes
        - Some materials may release harmful gases when cut
- 3D printer/Additive Manufacturing
    - Fused Deposition Modelling (FDM)
        - Plastic is melted and deposited strip by strip
    - Selective Laser Sintering (SLS)
        - Uses lasers to fuse powered material into solid form
        - Powder moves to work area, and laser adds a thin layer to the existing shape
        - Tends to produce better results than FDM
        - No need of support structures
    - Advantages
        - Make complex, fully 3D models
        - Take CAD files and great models
    - Limitations
        - Slow machines
        - Materials are limited
    - Considerations
        - Structures can't be too thin or have too many unsupported internal features

M3-W11-V2-Occupational Therapist Stakeholder

- Learning goals

    - Describe the role of an occupational therapist
    - Explain the purpose of assistive technology and how it is used
    - Identify the parameters that are important for adoption and design of assistive technology
    - Explain key elements to consider when collaborating with occupational therapists
- Emma Smith
    - Occupational therapist. Focus on assistive technology and wheelchairs
    - Occupational therapy: enable participation and independence in society. Help people achieve the people they need, want, or are expected to do
- Assistive technology
    - Commercially available or custom made
    - items, equipment, or product that increase, maintain, or improve functional capabilities
    - Consider: user's experience (the context of the user and their lifestyle), usefulness of device, ease of use, simplicity, learning and ongoing support required, and social context (look good and look normal)
    - Usefulness might overpower complicated. But it depends
- When assistive technology goes wrong
    - If it doesn't work, people won't use it because it's not useful
- When it works
    - Benefits people greatly, and is useful. For example, lever on wheelchair

M3-W11-V3-Elevator Pitches

- Learning goals
    - Describe how Clear, Concise, and Complete (from the 7 Cs of Communication) apply to professional communication
    - Explain what an "elevator pitch" is and how it is used
    - Describe the key elements of an elevator pitch
- Framework: Audience, Purpose, Context -> good presentation
- Framework: 7 Cs
    - Clear, correct, concise, concrete, complete, courteous, considerate
- Clear, concise, complete
    - Clear
        - Easy to follow, easy to understand, unambiguous in message
    - Concise
        - Brief, to the point, free of unnecessary language
    - Complete
        - Includes all relevant information to the message, clearly conveys what you want from the recipient
- Elevator pitch
    - By luck, you ride the elevator with influential individuals. 30 second elevator ride, chance to communicate great idea
    - A succinct summary of an idea, product, service, or other solution. It is intended to generate interest and start a conversation

- 1. what is the problem you are trying to address?
  2. What is your solution to address it?
  3. Why is it important to the audience?
- Must be clear, concise, and complete

M3-W12-V1-Technical Memos

- Learning Goals
  - Describe how Correct and Concrete (from the 7 Cs of Communication) apply to professional communication
  - Explain what a "technical memorandum" is and what it is used for
  - Describe the key elements of a technical memorandum
- Correct and Concrete
  - Correct
    - Message is factually and grammatically accurate, adhering to standards of business communication
  - Concrete
    - Precise, specific and detailed instead of vague
    - Precise numbers and information
    - Overlaps with clear and complete
  - Added info that is necessary: better example of complete
  - Added info that is helpful: better example of concrete
- Technical Memorandum
  - For sharing their designs and recommendations. Communication within people in an organization or office
  - Main Memo
    - Header: date, sender, recipient, subject
    - Introduction: purpose and topic of memo
    - Main body: elaborates on problem and solution development process
    - Conclusion: summary of findings and emphasizes recommendation
      - No new info
  - Appendices
    - Detailed info that will be distracting in the body
    - Appendices should be referenced in the main body

M3-W13-V1-7 Cs and Feedback

- Learning Goals
  - Describe how Courteous and Considerate (from the 7Cs of Communication) apply to professional communication
  - Describe three types of feedback in the workplace
  - Apply principles of Concrete, Complete, and Considerate communication in developing effective written feedback

- Courteous and Considerate (strong overlap)
    - Courteous
        - Correct, respectful, and sincere
    - Considerate
        - Keep audience in mind
        - Empathetic, mindful, positive, and with emphasis on what is possible
    - Difference
        - Courteous: respect for general audience
        - Considerate: taking into account the specific audience
- Giving feedback
    - Types of feedback
        - Appreciation: give credit/thanks
        - Coaching: help someone improve
        - Evaluation: rate someone's performance against standards
    - Sender -> (message) -> Receiver -> (response)
    - APSC 100: focus on message
    - 3 main Cs for feedback:
        - Concrete: descriptive, specific, and non judgmental message
        - Complete: relevant details, impact and suggestions for improvement
        - Considerate: empathetic, relevant, focus on what is possible

7 Cs Summary

- Clear
    - Easy to follow
    - Easy to understand
- Correct
    - Factually accurate
    - Correct in grammar and format
- Concise
    - Brief
    - To the point
- Concrete
    - Detailed, vivid, and specific
    - Clear in its main point
- Complete
    - Includes information relevant to audience
    - Conveys what audience should do
- Courteous
    - Sincere and genuine
    - Polite and respectful
- Considerate

    - Empathetic and mindful
    - Prepared and delivered with audience in mind

Things to review for final exam

- 7 Cs
- Elevator pitch