

University of Toronto
Faculty of Applied Science and Engineering
Final Examination, December 9, 2016

Duration: 2.5 hours

APS111H1 F and APS113Y1 Y - Engineering Strategies & Practice 1

Calculator Type: 4 (No electronic or mechanical devices permitted)

Exam Type: A (Closed book, no aids permitted)

Course Coordinator: Jason Bazylak

Communication Coordinator: Peter Weiss

Module A Coordinator: Susan McCahan

Module B Coordinator: Jacinta O'Brien

Instructions:

This is a closed book exam; no calculators or aids are permitted, except a translation-only non-electronic dictionary, i.e., direct word-to-word translations with no definitions.

To start: Fill out both the answer sheet (scan sheet) and the exam booklet (blank lined booklet) with:

- Your name: on the back of the answer sheet and on the front of the exam booklet
- Your student number
- Your course: APS111 or APS113
- Today's date: 09-Dec-2016
- You **do not** need to fill out the course instructor or form code

There are two parts to the exam: (1) multiple-choice questions, and (2) a writing component.

Multiple-Choice (60%):

- There are a total of 34 multiple-choice questions, each of which is worth about 1.7 marks, for a total of 60 marks worth 60% of the exam.
- **Answer this part on the answer sheet (scan sheet with bubbles):** do not answer the multiple-choice questions on these question pages or in the exam booklet.
- Read each question carefully and choose the most correct answer.
- **Only one answer is to be given for each question.**
- There is no penalty for incorrect answers.
- Be sure to fill out the answer sheet **clearly and darkly with no overlaps**, using a pencil.
- Erase any errors completely.

Writing Component (40%):

- The second part of the exam is a writing component worth 40% of the exam.
- **Answer this part in the exam booklet (blank lined booklet):** do not answer the written component questions on these exam question pages.
- Carefully follow the instructions.

When you are done the exam, insert the answer sheet (scan sheet) into the exam booklet and hand in both together. You may keep the question pages.

Part 1: Multiple-choice questions (60%)

1. EpiPen® is an injection system that is used to administer Epinephrine to people who are having an allergic shock. Epinephrine is a chemical that reverses the physiological changes, such as severe low blood pressure, wheezing, and severe skin reactions, that characterize allergic shock. The EpiPen® has an orange coloured cap over the built-in needle, which contrasts with the blue-coloured safety cap. Instructions for using the EpiPen® state: "blue to the sky, needle to the thigh". The use of orange and blue in the design of the EpiPen® demonstrates that design engineers took which of the following into consideration?
 - a. Safety.
 - b. Human Factors.
 - c. Adaptive capacity.
 - d. Economic, Environmental, Social.
2. Based on the Brundtland Commission definition of sustainable development, which of the following statements is **TRUE**?
 - a. Sustainable development does not encourage resilience.
 - b. Sustainable development only applies to developing countries.
 - c. Sustainable development enables future generations to meet their own needs.
 - d. Sustainable development cannot be applied to engineering designs because it is a United Nations initiative.
3. Students in APS111 who texted in answers to Top Hat questions but who were not in lecture were entered in the Student Participation Incentive Program and were eligible to be randomly selected for a \$10 iTunes card or \$10 Tim Card. Which of the following statements is **TRUE** about the behaviour of these students:
 - a. The behaviour was legal and ethical.
 - b. The behaviour was legal, but unethical.
 - c. The behaviour was illegal, but ethical.
 - d. The behaviour was illegal and unethical.
4. Which of the following statements about Life Cycle Assessment is **FALSE**?
 - a. LCA is a method for analyzing the environmental impacts and costs associated with a design, which can be useful for comparing design alternatives.
 - b. LCA is concerned with the environmental impacts associated with the acquisition and processing of raw materials and the distribution and use of the design, but not with disposal of the design.
 - c. LCA could be used by the Bank of Canada to compare the environmental impacts of cotton-based paper bank notes to bank notes made using a polymer.
 - d. Two different LCAs can yield two different results even when both LCAs are used to compare cloth diapers with disposable diapers.

5. On November 3, 2016, Professional Engineers Ontario (PEO) issued a news release stating that Emmanuel de Guzman and Falcon Group International Inc. had been convicted of four counts of breaching the Professional Engineers Act and fined \$10,000. Falcon Group was found guilty of two counts for offering professional engineering services through its website and using restricted terms, titles and descriptions in a LinkedIn profile. De Guzman, as a director and officer of Falcon Group, was found guilty of authorizing, permitting or consenting to the offences. De Guzman has never been licensed as a professional engineer in Ontario. The verdict was made on October 28 by His Worship Justice of the Peace Sunny Ng. The convictions of Emmanuel de Guzman and Falcon Group demonstrate that the practice of engineering:
- Can be carried out by anyone so long as they are not convicted of breaching the Professional Engineers Act.
 - Is governed by the Professional Engineers Act, but the Act only applies to individuals who are licensed as professional engineers.
 - Is not a self-regulated profession.
 - Restricted to only those individuals who are deemed qualified by PEO.
6. Which of the following statements about applying Triple Bottom Line to the Temporary Emergency Cold Weather Protection for the Homeless is **TRUE**?
- Triple Bottom Line analysis should be applied to the Temporary Emergency Cold Weather Protection for the Homeless to demonstrate the sustainability of the design.
 - Triple Bottom Line analysis does not need to be applied to the Temporary Emergency Cold Weather Protection for the Homeless because the design has no environmental impacts.
 - Triple Bottom Line analysis cannot be applied to the Temporary Emergency Cold Weather Protection for the Homeless because it is not possible to quantify the social benefits of the design.
 - Triple Bottom Line analysis must be applied to the Temporary Emergency Cold Weather Protection for the Homeless otherwise the client and the local community will not understand the benefits of the design.
7. The City of Toronto's Municipal Licensing and Standards department is responsible for issuing licenses for a range of businesses, such as food trucks, nightclubs, and retail stores, and for enforcing the City's by-laws to ensure that the businesses are complying with them. Which of the following statements about City of Toronto by-laws is **FALSE**?
- By-laws are true laws, so Toronto businesses must comply with them.
 - If a by-law conflicts with a government of Canada regulation, the regulation takes precedence.
 - John Tory is the Mayor of Toronto.
 - Toronto's by-laws apply throughout Ontario.

8. The APS111 teaching team, who jointly created this exam, consisted of Professors Weiss (Expressive), O'Brien (Analytical), and Bazylak (Amiable). Their respective preferred leadership styles are included in brackets. To create an effective team dynamic:
 - a. One team member should flex beyond their natural preferences to undertake an organizational role (driver).
 - b. Professors O'Brien and Bazylak should let Professor Weiss run the team.
Expressive leaders are creative and therefore create the best team dynamic.
 - c. Professor Bazylak, as the Amiable leader, should ensure that team conflict is avoided.
 - d. All team meetings should be moved online to ensure buy-in from all team members at team meetings.
9. Chlorofluorocarbons, also known as CFCs, were invented in 1928 by a mechanical engineer as an inflammable and non-toxic refrigerant. CFCs proved to be so versatile, they were produced in very large quantities and used in many applications. However, in 1974, scientists discovered that CFCs were depleting the ozone layer. To prevent further degradation to the ozone layer, countries around the world voluntarily adopted the Montreal Protocol and agreed to stop producing and using CFCs, and to conduct research to find alternatives to CFCs. Which term best describes the adoption of the Montreal Protocol and the agreement by countries to stop using CFCs?
 - a. Impact on Society.
 - b. Industrial ecology.
 - c. Legislation.
 - d. Recycling.
10. Which statement about break even analysis and payback period is **TRUE**?
 - a. Break even analysis is based on time, and payback period is based on quantity.
 - b. Payback period cannot be applied to government projects.
 - c. Both break even analysis and payback period are based on analysis of profit.
 - d. None of the above.

Q11 - 22 pertain to Case Study #1: Autonomous Vehicles located in Appendix A.

11. Driving a motor vehicle while the driver is not sitting in the driver seat is currently prohibited under Subsection 3(6) of Ontario Regulation 455/07 of the Highway Traffic Act (HTA). Given that this technology is evolving, Ontario's test program requires that a driver be in the autonomous vehicle that is being tested in order to be able to take control over driving the vehicle in case an unexpected event occurs. By including Subsection 3(6) in the Regulation the Ontario provincial government:
 - a. Balances people, planet, profit.
 - b. Ensures society operates in a safe and orderly manner.
 - c. Imposes an undue financial burden on car manufacturers.
 - d. Will lose the next election.

12. Which of the following statements about the use of autonomous vehicles to provide increased mobility for the young, elderly, and the disabled is **TRUE**?
- Wheel Trans would need to hire more drivers to accommodate young and elderly users.
 - Provides an unintended social benefit.
 - Promotes sustainability.
 - Could increase insurance premiums for autonomous vehicle owners because the young, elderly and disabled users would not be able to take over driving the vehicle in case an unexpected event occurs.
13. According to the Ontario Ministry of Transportation, in 2013, the transportation sector was the largest source of volatile organic emissions and nitrogen oxide emissions, both of which have been linked to climate change. Autonomous vehicles have the potential to make the movement of vehicles more efficient and this could lead to an overall reduction in traffic congestion and fossil fuel consumption. As a result, the use of autonomous vehicles:
- Will require special Legislation to protect the public.
 - Promotes biodiversity because the autonomous vehicles produce an environmental benefit.
 - May encourage a change from fossil fuels to other, renewable sources of energy.
 - Could contribute to a reduction in emissions of the pollutants that are contributing to climate change.
14. Honda's new Civic LX Sedan can now be purchased with the option of full autonomous driving capability. In order to be able to offer the option in the United States, Honda was required to demonstrate that the autonomous driving features meet the standards set by the International Organization for Standardization (ISO), specifically ISO 26262, which is concerned with preventing the incorrect functioning of an electronic system that could impact on the overall safety of the vehicle. Honda is now importing the Civic LX Sedan into Canada. The purchase price of the Civic LX Sedan makes it attractive to first time car buyers. For car buyers in Toronto, which of the following statements is **TRUE**?
- Toronto buyers will not be able to purchase the Civic LX Sedan because the government of Ontario is responsible for importing products into the country.
 - Too much government control over goods imported into Canada is having a negative impact on the economy.
 - If Toronto buyers rely on the ISO certification of the Civic LX Sedan with full autonomous driving capability, then the Ontario government no longer needs to complete the 10-year test program.
 - By meeting the ISO 26262 standard, Honda provides Toronto buyers with quality assurance that the electronic system of the Civic LX Sedan functions correctly.

15. Tesla Motors Incorporated (Tesla) is a competitor of Honda Corporation. Tesla makes electric cars and has started to equip its Model S with full self-driving capabilities. Tesla has hired Panasonic Corporation to produce the lithium-ion batteries, which are the preferred choice for hybrid and electric vehicles. Panasonic intends to build a factory to manufacture the automotive lithium-ion battery in China, as a joint venture with a Chinese company. The factory will be built in the northeastern city of Dalian, Liaoning Province, at an estimated cost of 50 billion yen (\$412 million, in U.S. dollars), and should be fully operational by 2017. Manufacturing the batteries at the new factory will incur a number of different types of costs. Which one of the following statements about the costs is **TRUE**?
- Rent and taxes paid for the manufacturing facility are variable costs.
 - The cost of the lithium salt used to manufacture the batteries represents a fixed operating cost.
 - The cost to build the factory is a one-time capital cost.
 - Worker's hourly wages are not included in the costs because the Chinese company will pay the wages.
16. Tesla Motors Incorporated (Tesla) has hired you as a design engineer to design Tesla's first generation of autonomous vehicle. Tesla has instructed you to base your design on the combination of control systems that will result in the lowest cost and least environmental impact. You and your team initially developed a very large number of options based on different combinations of radar sensors, video cameras and LIDAR. Through various techniques and analyses, you and your team reduced the number of options to 10. You and your team must now decide on a quick decision-making method to further eliminate options. Which of the following statements best describes what you and your team will choose?
- Multi-voting should be used because it is simple and can be applied to a very large number of options.
 - A Graphic Decision Chart should be used because it works well if there are two objectives.
 - The Pugh method should be used because it works best when applied against an existing technology that has a standard set of goals.
 - There are no methods that can be applied to autonomous vehicles because Tesla is not taking social aspects into consideration as an objective for the design.
17. During a meeting with your design team, one of the team members describes ISO2575, a standard that specifies the symbols for controls and indicators on vehicle dashboards. Which of the following statements about standards is **TRUE**?
- Standards can rely on or reference other standards.
 - All standards are written in SI units, which is a global requirement.
 - Your design team must reference and use ISO2575 in requirements.
 - Regulations and standards have the same enforcement priority.

18. Your design team is evaluating responses to an RFP on behalf of Honda Corporation. The RFP is for a project to design a new autonomous vehicle prototype. Honda Corporation had the following objectives for the interior space of the prototype: (i) enhance occupant experience, (ii) facilitate communication between occupants and the vehicle control systems, and (iii) promote the Honda Corporation to potential vehicle buyers. In which section of the submission would you expect to see references to the objectives?
- Project Requirements.
 - Alternative Designs.
 - Proposed Conceptual Design.
 - All of the above.
19. As a design engineer working on a project for Honda Corporation, which of the following statements is **TRUE**?
- You do not consider Honda Corporation to be a stakeholder because you know Honda's interests and influence on the project.
 - You consider Honda Corporation to be a stakeholder because Honda pays your salary.
 - You do not consider Honda Corporation to be a stakeholder because Honda is a private company.
 - You consider Honda Corporation to be a stakeholder because Honda has told you about its interest and influence on the project.
20. You are a licensed professional engineer working on Tesla Motor Corporation's proprietary LIDAR system. Your 2T0 classmate just got a job at a start-up company that is working on a new type of LIDAR system, and brags to you about making \$20,000 more a year than you. Your classmate tells you about another job opening at the start-up company: all you need to do to be hired is to explain Tesla's LIDAR system during the job interview. As a licensed engineer, you would not do this because:
- Engineering is a closed profession.
 - You are bound by the Code of Ethics.
 - You are competent.
 - You do not want to be labelled as a "Whistle-Blower".
21. The Ontario Ministry of Transportation has identified three potential outcomes related to autonomous vehicles, namely: (1) fewer traffic collisions through improved collision avoidance and reduced driver error, (2) reduced traffic congestion, and (3) convenience, time savings and lower stress for drivers and commuters. These potential outcomes are best described as:
- Economic.
 - Environmental.
 - Social.
 - Sustainable.

22. Honda Corporation recently built a new manufacturing facility in Tillsonburg, Ontario, where many other, diverse manufacturing facilities are located. The new Honda facility will be part of an industrial symbiosis (industrial ecology). However, the Ontario government has just announced new regulations that require companies to recycle their old containers and packaging materials. Should Honda Corporation be concerned about the new regulations?
- No, because a guiding principle of industrial ecology is that most inputs should be obtained through recycling.
 - No, because industrial ecology cannot be regulated.
 - No, because Honda will send its old containers and packaging materials to landfill.
 - Yes, because other companies in the industrial symbiosis might move to Toronto.

End of questions pertaining to Case Study #1: Autonomous Vehicles located in Appendix A.

Q23 - 34 pertain to Case Study #2: Colonizing Mars located in Appendix B.

23. Which of the following statements is **TRUE** about the economic interest that NASA and SpaceX each have in colonizing Mars, as measured by payback period?
- Both NASA and SpaceX are interested in the longest payback period.
 - Both NASA and SpaceX are interested in the shortest payback period.
 - NASA is interested in the longest payback period and SpaceX is interested in the shortest payback period.
 - Payback period does not apply to NASA because it is funded by the government of the United States.
24. What statement best describes the findings of the research group that recently completed the study of vegetables grown in a soil that mimics the soil on Mars?
- Biomagnification does not apply to heavy metals because they are inorganic.
 - Biomagnification of heavy metals will not occur in people who consume vegetables grown in soil from Mars.
 - Biomagnification will be deactivated due to radiation.
 - The study did not produce enough information to make a conclusion about biomagnification.
25. SpaceX has stated that it would like to lower the retail price of a trip into space to \$100,000 per person. If SpaceX is able to reduce the variable cost per person per flight to \$96,000 and the annual fixed costs for all flights to \$8,000,000, what is the minimum number of persons required for SpaceX to break even?
- 1,200
 - 1,800.
 - 2,000
 - 2,400.

26. SpaceX has indicated that transportation costs can be lowered to \$200,000 per person by emphasizing reusability in the design of its spacecraft. **Table 1** shows three different sets of values for the variable cost per person and annual fixed costs to transport people into space. You are the design engineer responsible for the options analysis, and must present the most profitable option to the CEO of SpaceX. Which option?
- Option A.
 - Option B.
 - Option C.
 - There is not enough information to choose among the options.

Table 1 for Question 26.

Option	Values for Each Option		
	Number of Persons Per Flight	Variable Cost per Person per Flight	Annual Fixed Costs for All Flights in the Year
A	200	\$150,000	\$10,000,000
B	180	\$120,000	\$12,000,000
C	240	\$100,000	\$25,000,000

27. As a design engineer for NASA, you have been evaluating different types of rocket fuels. Your team leader has just given you economic news from the World Bank, which states that the global rate of inflation (as measured by the Consumer Price Index, or CPI, in Canada) has remained the same for the past year. Which statement is **TRUE**?
- Inflation is a macroeconomic factor that can affect fuel prices.
 - Inflation is a microeconomic factor that can affect fuel prices.
 - Inflation is a macroeconomic factor, but it cannot affect fuel prices.
 - Inflation is a microeconomic factor, but it cannot affect fuel prices.
28. Every year companies spend millions of dollars to dispose of billions of kilograms of chicken feathers, mainly by burning them or burying them in landfills. NASA has been researching fuel storage systems for use on its first manned mission to Mars and has found that carbonized chicken feathers are a much more economical alternative. When the chicken feathers are heat treated by controlled pyrolysis, hollow carbon tubes are formed that have the same properties (e.g., very large surface area within a compact volume) as nanotubes. The heating of carbonized chicken feathers to create hollow carbon tubes is an example of which of the following?
- Reducing.
 - Reusing.
 - Recycling.
 - All of the above.

<< More questions on the next page >>

29. NASA analyzed three different types of landing mechanisms using the Pugh Method. The results are shown in **Table 2**. Based on the results, which of the following statements is TRUE?
- The Strut Rear Landing Gear is the best.
 - The Standard Landing Gear is the best.
 - The Retractable Landing Gear is the best because it scored highest on Safety.
 - The Retractable Landing Gear and the Detachable Landing Gear are the best because the scores are the same.

Table 2 for Question 29.

Objective	Standard Landing Gear	Retractable Landing Gear	Detachable Landing Gear	Strut Rear Landing Gear
Cost	0	0	-1	-2
Operation Time	0	-1	0	-1
Safety	0	+1	-1	0
Volumetric Requirements	0	-1	0	-2
Weight	0	-1	0	-1
Sum	0	-2	-2	-6

30. Using a Weighted Decision Matrix would overcome which of the following disadvantages of the Pugh Method?
- The Pugh Method does not account for the relative importance of each of the objectives.
 - The Pugh Method is time-consuming and difficult to use.
 - The Pugh Method can only be applied to Objectives.
 - The Pugh Method cannot be applied to space craft.
31. SpaceX has announced plans to build a solar-powered factory on Mars that will use the carbon dioxide and water ice in the planet's air and soil, respectively, to generate methane and oxygen. Which of the following best describes the energy source that SpaceX plans to use?
- Third Party certification.
 - Renewable.
 - Microeconomic.
 - Environmental emissions.
32. To design the ideal conditions on Mars for a colony of people, NASA has decided to use the latest trends in the field of human-centered design, which increasingly involves taking into account which of the following as part of the design process?
- The stakeholder's interests.
 - The service environment on Mars.
 - The colonist's physical measurements, such as anthropometric data.
 - The colonist's emotional needs.

33. NASA is developing a habitat to be built on Mars to protect the first colony of humans from the harsh atmosphere and to simulate gravitational and other conditions similar to those found on Earth. NASA is using a honeycomb structure, as is found in beehives. This is an example of which of the following?
- Resilience.
 - Natural Environment.
 - Biomimicry.
 - Adaptive Capacity.
34. Operation of the habitat that NASA builds on Mars, will involve releasing wastes, in the form of air and solid waste emissions, into the Martian atmosphere. NASA does not want to contribute any unnecessary pollution to the cosmos, so will install technologies to treat the emissions after they have been created. By so doing, NASA will be practicing:
- Pollution Prevention.
 - Pollution Control.
 - Due Diligence.
 - Bioaccumulation.

End of questions pertaining to Case Study #2: Colonizing Mars located in Appendix B.

End of multiple-choice questions.

<<Long-answer questions start on the next page>>

Part 2: Long Answer Questions (40%)

Questions 35 to 37 are based on Case Study #3: RFP for a Personal Data Management Assistant, located in Appendix C.

INSTRUCTIONS: This section requires 3 written answers. Use an exam booklet, and write in your name, student number, course, and date of examination on the booklet's cover page. You may use as many pages as you need for your preliminary work, but the final answers must be no more than four (4) pages single-spaced or eight (8) pages double spaced. Clearly indicate the final copy to be graded by writing "Final Copy" at the start of it. Use full sentences and paragraphs and bullet lists where appropriate.

This section of the exam evaluates your ability to

- Read, understand, and analyse engineering-related material under time pressure
- Communicate in clear, concise, well-organized sentences and paragraphs with minimal error
- Structure a logical argument, making clear claims and supporting them with the evidence currently available to you
- Recognize the kinds of information you would need, moving forward, to validate and better support your claims and generate specific questions to help you find that information

35. Based on Case Study 3: RFP for a Personal Data Management Assistant, located in Appendix C, in paragraph form (one or more paragraphs) write a concise Problem Statement in your own words. You may, if you wish, add a brief introduction, identifying the client. DO NOT COPY SENTENCES WORD-FOR-WORD FROM THE CASE STUDY IN YOUR PROBLEM STATEMENT. YOU WILL RECEIVE NO MARKS FOR MATERIAL COPIED WORD-FOR-WORD FROM THE CASE STUDY. (20 marks)
36. Based on Case Study 3: RFP for a Personal Data Management Assistant located in Appendix C, generate Functions, Objectives and Constraints. Utilize course tools such as Functional Basis and Functional Decomposition. In total, you should have about 10 items, whether they are Primary Functions, Secondary Functions, Unintended Functions, Objectives or Constraints. Treat this like a section of a design document with a section introduction and sub-sections. Introduce each of the sub-sections (e.g. Functions, Objectives, Constraints) with a few sentences that help the reader understand their nature and significance. (15 marks)
37. Identify five key research questions you would want to answer in order to check the validity of your claims and to develop the three top objectives further. These are questions to guide your personal research, NOT questions for the client. (Don't worry about whether the questions are open or closed.) (5 marks)

End of all questions for this exam.

You may remove these appendices.

Appendix A: Case Study #1: Autonomous Vehicles

Autonomous vehicles, also known as driverless vehicles, are capable of travelling between destinations without human operators. Various predictions forecast that by 2030 up to 15 percent of new cars in North America could be fully autonomous. [1]



Source: <http://media.caranddriver.com/images/media/51/google-is-my-co-pilot-what-can-go-wrong-inline-1-photo-469797-s-original.jpg>

Autonomous vehicles are equipped with various sensors that work in conjunction with each other to control a driverless car by detecting its surroundings:

- Radar sensors monitor the position of vehicles nearby.
- Video cameras interpret traffic lights and road signs, and detect pedestrians and other obstacles.
- LIDAR, which stands for Light Detection and Ranging, is a remote sensing method that uses light in the form of a pulsed laser to measure distances and is used to detect the edges of roads and lane markings.

Estimates of the costs for the various components required to retrofit a vehicle to become autonomous could add up to \$10,000 to the base cost of the vehicle. However, in early 2016, Honda announced that its new Civic LX Sedan could be purchased with full autonomous driving capability for only \$20,440 (U.S. dollars) [2]. This is only \$1,423 (U.S. dollars) more than the average price for a new Civic LX Sedan without autonomous driving capability. [3]

A 2016 research report by Rand Corporation found autonomous vehicles offer the possibility of significant benefits: fewer vehicle crashes; more efficient traffic flow; less traffic congestion; lower fuel consumption; less pollution; and, increased mobility for the young, the elderly, and the disabled. [4] The same research report described drawbacks, including the potential loss of occupations and economies based on public transit, vehicle repair, and insurance.

On January 1, 2016, the Ontario provincial government began allowing the testing of autonomous vehicles on Ontario's roads. The testing period will last 10 years. Ontario is the first jurisdiction in Canada to allow autonomous vehicles on its roads. [5] In the United States, California, Michigan and Nevada have passed detailed legislation that allows the operation of autonomous vehicles, but currently allow them on public roads for testing purposes only. [6]

References

*Note that this reference section is intended to model proper referencing techniques, but you are **NOT** expected to read all these primary sources. All information required for the final exam is included in the case study.*

References

- [1] City of Toronto (2016, May). "Preparing the City of Toronto for Autonomous Vehicles". Decision of the Public Works and Infrastructure Committee. [Online] Available: <http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2016.PW13.14>
- [2] Zillman, Claire (March, 2016). "You Can Buy This Self-Driving Car for \$20,000" *Fortune*. [Online] Available: <http://fortune.com/2016/03/14/self-driving-car-honda/>
- [3] "2016 Honda Civic Sedan Pricing". [Online] Available: <http://www.edmunds.com/honda/civic/2016/sedan/>
- [4] Anderson, James M., et al. (2016). Autonomous Vehicles – A Guide for Policy Makers. RAND Corporation. [Online] Available: http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-2/RAND_RR443-2.pdf
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- [6] Reynolds, Michael W., and Jason Orr (2016, July). "A State-By-State Guide to Driverless Car Regulations". *Law360*. [Online] Available: <http://www.law360.com/articles/819698/a-state-by-state-guide-to-driverless-car-regulations>

Appendix B: Case Study #2: Colonizing Mars

In October, 2015, the National Aeronautics and Space Administration (NASA), an agency funded by the government of the United States, released a plan, called “Journey to Mars – Pioneering Next Steps in Space Exploration” [1]. The plan explains how NASA will extend human presence deeper into the solar system by sending people to Mars.

NASA has developed a resilient approach for implementing the plan, elements of which are presented in Table 1.

Table 1. Features of NASA’s Resilient Approach for Implementing the Plan directly from [1, p.12]

<i>Logistics</i>	<i>Design to minimize the number of systems, use them multiple times, refresh instead of replace, and maintain with local resources to enable self-sufficient missions</i>
<i>Modularity</i>	<i>Standardize for flexibility, simple interfaces to enhance complex subsystems and components</i>
<i>Commonality</i>	<i>Develop systems that serve multiple purposes across the campaign at many destinations</i>
<i>Extensibility</i>	<i>Develop initial hardware with paths for enhanced applications</i>
<i>Affordability</i>	<i>Optimize system development across a campaign, not a mission to minimize development costs</i>

NASA acknowledges there are many challenges to colonizing Mars and has categorized them into 3 areas: (1) transportation to and from Mars; (2) systems and resources to support colonization; and, (3) long term health and well-being of the people who will be living and working on Mars [1].

Some researchers and scientists have speculated that there could be a colony of people on Mars by 2050. [2] However, using today’s technology, the transportation cost for a trip to Mars has been estimated at \$10 billion per person. [3] To help overcome challenges and to reduce the high cost of transportation to and from Mars, NASA is working with SpaceX, a private sector company. SpaceX designs, manufactures and launches advanced rockets and spacecraft, and, according to its website, is the only private company ever to return a spacecraft from low-Earth orbit, which it first accomplished in December 2010. [4] Since then, SpaceX’s Dragon spacecraft has been used to deliver cargo to and from the International Space Station numerous times, providing regular cargo resupply missions for NASA. SpaceX emphasizes reusability in its designs, and believes the cost for transportation can be lowered to less than \$200,000 per person, and ultimately to less than \$100,000. [3]

Supporting colonization requires resources, including food. Rather than bringing resources from the Earth to Mars, engineers and researchers are examining ways that resources on Mars could be used instead. One research group recently completed a study that found vegetables, specifically, radishes, peas, rye, and tomatoes, grown in a soil that mimics the

soil on Mars are safe for humans to eat. [5] The researchers used the concentrations of heavy metals in the vegetables as the indicator of safety. The researchers detected no dangerous levels of aluminium, copper, iron, manganese, zinc, arsenic, cadmium, chrome, nickel or lead in the vegetables that were grown, and, thus, concluded that the vegetables were safe to eat.

Exposure to radiation is of significant concern to NASA because of its potential long term effects on health and safety. According to space scientists, people living and working on Mars would be exposed to high-energy particles, including infrequent, but potentially deadly, solar particle events, and constant exposure to galactic cosmic rays. These high-energy particles can reduce immune response, and increase cancer risk. NASA's Human Research Program is developing methods and technologies to protect, mitigate, and treat the effects of radiation. [1]

References

*Note that this reference section is intended to model proper referencing techniques, but you are **NOT** expected to read all these primary sources. All information required for the final exam is included in the case study.*

References

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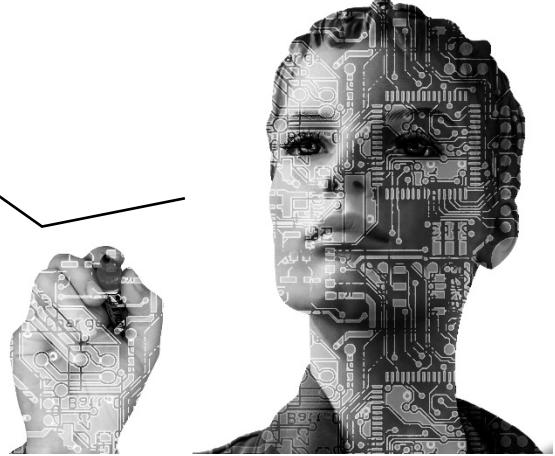
Appendix C: Case Study #3: RFP for a Personal Data Management Assistant

Focalize Inc.

Request for Proposals (RFP)

For a Personal Data Management Assistant

My name is ESPA and I use Artificial Intelligence to brief you on what you need to know about what is going on in *your* world today.



[1] Image on Public Domain, free for commercial use

Humans today have exceptional means to understand the world around them, but they are, in Arianna Huffington's words, "Drowning in data and starved for wisdom...We are more at the mercy of events and the accelerated change that is happening everywhere." [2] World leaders have teams that search through newspaper articles, analyse reports, and provide condensed briefings that enable leaders to make better decisions. But what do ordinary people have? Between news reports, emails, texts from family and friends, social network postings, blogs, we can be overwhelmed not knowing what to read, what to ignore and even where to look for the most reliable and intelligent material. The problem has been made even worse by the recent emergence of "fake news." [3]

Consider, for example, the situation of a first-year university student in first term. The student is in a new school, a new unfamiliar work environment, meeting new people, perhaps far away from home and support network. The student is drowned with messages from the university, faculty, offices within the faculty, courses and their websites, other students on discussion boards, friends and family from home, and social networks, not to mention news reporting on events of concern around the world. How can the student make sense of it all quickly and be able to confidently approach their day?

Current apps, such as Google Now, Flipboard and even Facebook can be programmed to provide news and updates according to a user's preferences, but none of these apps actually go into the material and retrieve important highlights, which would make up a useful briefing. And so, for most of us, even with our preferences set, we are left confused and too often taken by surprise by world events that will affect our own personal well-being, our investments and other plans for the future.

But wouldn't it be great if you could get up in the morning, click a button and, in a few moments, be provided with a short, personal briefing about what you need to know in order to go through your day in the most effective way possible? Wouldn't it be great if, at any moment, you could click a button and, within a few moments, be provided with a short, personal briefing on any topic of interest to you? Wouldn't it be great if you were not only provided with the most important details, according to your own frame of reference, but

also counter-arguments from the best sources possible? A design for this sort of system or device is what we are looking for, here at Focalize, Inc.

Therefore, we are inviting proposals for a design for a tool that will provide periodic (daily, hourly or on demand) briefings to an ordinary user. The design should not be dependent on a particular device or platform and must be compatible with as many sources of data as possible. The trade-off between advertising based on personal preferences, allowing for a free system, and another form of monetizing the system should be considered in the proposal. Law enforcement and public security issues must also be taken into account. In addition, language should be considered – should the language of the original material be the language of the briefing or should the system be able to change the language?

Focalize is an independent company dedicated to helping ordinary people handle the life changing effects of current technology. We are not associated with any government branches; our tools and systems are financed through a combination of user fees and advertising revenues.

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