ABE 30100: Modeling and Computational Tools in Biological Engineering

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M/W/F 9:30 am – 10:20 am

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Syllabus: <syllabus-spring19.doc>

Schedule: <schedule-spring19.xlsx>

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# January 7, 2018

## Homework due today

* [Homework\honesty-homework.doc](Homework/honesty-homework.doc)

## Lecture

* [Presentations\intro-19.ppt](Presentations/intro-19.ppt)

## Quiz due January 14

* [Quizzes\Take\_Home\_Quizzes\quiz 1 take home 19 modeling.docx](Quizzes/Take_Home_Quizzes/quiz%201%20take%20home%2019%20modeling.docx)

# January 9, 2018

## Arguments vs. Models: parallel structure

* Knowledge
  + Inductive/deductive
  + Theory/observation
* Premises/assumptions
  + Accuracy/truth; Heap of Sand
  + Accuracy/quantification; parameters/relationships
* Conclusion/model
* Behavioral change/decision; Application/utility decision
* Same analysis/thinking skills needed for both

## Why is modeling so important to biological engineering?

* The foundation of major engineering disciplines is based on models (Newtonian motion, thermodynamics, fluid/heat/mass flow, reaction chemistry, Ohm/electricity, etc.)
* Models provide the means to efficiently evaluate process efficiency/product quality, economics, environmental impact, legal/governmental regulations
* What are the fundamental models of biological engineering?
* Models are only accurate under certain conditions
  + Get more data, learn to change model to be more accurate

## Modeling Process

1. Identify model output parameter(s), e.g. amounts, rate, time, expense, etc.
2. Identify input parameters and give each one a symbolic name, e.g. Time – t, mass – m, force – f, volume – v, density – r, etc.
3. Identify fundamental relationships between parameters, e.g. V = m/r, f = ma (note: these are essentially definitions
4. Identify principles, assumptions, basic theories, etc. that apply to problem, e.g. 1st law, conservation of mass, rate of reaction, etc. (note: these are often natural phenomena, theories, and constraints)
5. If possible, test the model or parts of the model on known data/circumstances
6. Assemble parameters and principles into relationships with regards to what is being asked
7. Inspect answer and make sure it is reasonable

## Questions about the modeling project

* Graded on the modeling process
* Iterations change the variables and assumptions
* Evaluate the final answer
* Evaluated on using the principles learned in previous classes
* Model must be time-dependent

# January 11, 2019

## Example Project: Fermenting Sugar to Make Alcohol

### Outputs

* Temperature, Pressure
* Alcohol Content
* Yeast cells

### Inputs

* Humidity
* Initial concentration of yeast
* pH

## Example: Ice Cubes in Water

* [temperature-of-water-in-glass-with-ice.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Professor_Notes/Modeling/temperature-of-water-in-glass-with-ice.docx)

### Outputs

* Temperature of water as a function of time

### Inputs

* Mass of water
* Initial temperature of ice
* Temperature of environment
* Surface area of ice
* Thermal conductivity of glass
* Initial temperature of water
* Volume of water
* Mass of water

### System Boundary

* Water in glass
* Surroundings: ice, room

### What is crossing the boundary

* Enthalpy of water to ice

### Identify principles, assumptions, basic theories, etc. that apply to the iteration system:

* Assumptions
  + Overall system is isolated
  + Find temperature at final state when all ice is melted
  + Assume no knowledge of thermodynamics or science
* Theories and principles
  + The simplest model would be a proportion model, i.e. the final temperature is related to the initial water temperature and proportional to the initial amount of ice in the glass

### Parameters/ variables, each with a symbolic name

* Two – initial liquid water temperature, [temp]
* K – proportionality constant, [temp/mass]
* Mio – initial mass of ice
* Tfinal – final ice temperature

# January 14, 2019

## Take Home Quiz 1 – Due Today

* [1-modeling.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Quizzes/Take_Home_Quizzes/Problems/1-modeling.docx)
* [atherton\_takehome\_quiz1.pdf](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Quizzes/Take_Home_Quizzes/My_Solutions/atherton_takehome_quiz1.pdf)

## Lecture Notes

* First iteration: assume no knowledge of anything
  + Proportional (linear) models: simplest mathematical quantification
    - Example: y = mx + b
* Second iteration: change assumption to improve model
  + Mass important because mass balance, everything is related to mass
* Third iteration: apply knowledge from previous classes

# January 16, 2019

## Lecture

* [Critical-Arguments.pptx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Presentations/Critical-Arguments/Critical-Arguments.pptx)

## Why Critical Thinking?

* “Reasoned, purposive, and reflective thinking used to make decisions, solve problems, and master concepts.” – Rudd, 2002
* “Everyone agrees that students learn in college, but whether they learn to think is more controversial.” – McKeachie cited in Joscely, 1988
* “We should be teaching students how to think, rather than what to think. To be competitive in a global environment, BFPE engineering students need to distinguish themselves by being able to reason clearly and creatively develop solutions to global challenges.” – Tao, 2008

## Good Critical Thinking/Analysis allows you to be effective

* Analysis
  + Ask critical questions
  + Develop/improve planned actions
* Thinking/argument development
  + Develop convincing, effective solutions
  + Develop clear, purposeful actions/plans based on reasoning
  + Persuade others to “buy in” to actions/plans

## Critical Arguments

### Objectives

1. Understand the structure/format of a critical argument
2. Learn how to read an article and extract/express the critical argument given
3. Learn to analyze a critical argument to determine if it is a strong argument
4. Learn to synthesize a strong critical argument

### Significance of Critical Arguments

* Explaining why we behave the way we do, i.e. choices, actions
* Persuade others to change their behavior/decisions/choices
* For engineers: translate technical knowledge/information into social/business context to make decisions, have impact, enable change/improvement

### Structure of Critical Arguments

* A set of premises: statements of information proposed as a basis for an argument (assumptions, presuppositions), e.g. ABE students are smart
* A conclusion: statement of an action/decision that rational, objective people would do based on the argument, e.g. ABE students should attend classes
  + A strong critical argument is one that compels a rational person to agree/obey its conclusion
* Notes
  + For the purposes of this class, a conclusion must be stated to require a behavior, i.e. you should do x
  + The conclusion should logically follow from the premises (validity)
  + Premises should be very carefully structured/worded to be able to clearly evaluate whether they are true (soundness)

### Analysis of a Critical Argument

* Premises are objective/accurate/true (called soundness)
  + Pure water boils at 212oF at 1 atmosphere of pressure (objective)
  + Women are attracted to tall men (subjective)
* Conclusion logically results from premises (called validity)
* A strong, compelling argument is one in which its premises are sound and its logic is valid

### Critical Arguments answer the important question of WHY?

* Why should you get a promotion/raise?
* Why must food beyond its expiration date be removed from sale in the U.S.?
* Why is it acceptable to have an average of 150 insect fragments per 100 grams of flour?
* Why are you in ABE at Purdue?
* Why should company X give you an internship?
* Why should Dr. Tao give you a high grade in ABE 301?

### Example (Format)

* Premises
  1. Antibiotics kill active pathogenic bacteria.
  2. The presence of active pathogenic bacteria in people makes them ill.
  3. People do not wish to be ill.
  4. (People should act in ways to fulfill their wishes.)
* Conclusion
  + Therefore, people who are ill should take antibiotics.
* Note specifically the use of the word “should” (or its equivalents, e.g. must, ought, etc.) in a conclusion, which is used to require/indicate an action or change in behavior.
  + Note implied premise

### Critical Argument Structure: Premises

* The accuracy/truthfulness of a premise is called soundness. Part of the analysis of the strength of an argument depends on the soundness of its premises.

### Heap of Sand

* Suppose that we dumped a heap of sand on the side walk
* Now remove the sand, one grain at a time. At what point would we no longer have a heap?
* It seems as though when we started we clearly *did* have a heap of sand, and by the time we got almost to the completion of the task, we clearly did not.
* When is a heap not a heap? (This is generically known as Sorites’ Paradox.)

#### What is a heap?

* How might a technical person, such as an engineer or scientist normally answer this kind of question? Would the answer be different for a non-technical person, such as an artist, historian, economist, or musician?
* Is there indeed a correct value of number of grains of sand in a heap or is there no satisfactory answer?
* What, if anything, is the source of the apparent problem? What, if anything does this example suggest about our ability to categorize, and to think precisely?
* Are there analogous problems facing engineers, scientists, or other technical disciplines in society? How about non-technical disciplines, such as politicians, lawyers, civil rights activists, and medical professionals?
* Many engineering students state that they would eventually like to become corporate managers or decision makers in a company. To be successful, you must determine a course of action and then garner support and participation from all these people. What kinds of skills would you need and how might you accomplish this? How is this different for graduates of different disciplines (e.g. engineering, history, medicine, law, music, etc.)?
* WORDS ARE VAGUE.

### Inductive vs. Deductive Premises

* Inductive (specific observations 🡪 generalization; based on specific observations/specific to general)
  + Every apple I have ever seen has been red. There are apples at the grocery store. Therefore, the apples at the grocery store must be red.
* Deductive (premises 🡪 conclusion; based on definitions, principles/general to specific)
  + All rectangles have four sides. A square has four sides. Therefore, a square is a rectangle.

### Subjective vs. Objective Premises

* An objective (or non-subjective) premise is one in which there is factual or generally agreed upon criteria for evaluating the soundness of the premise.
  + Examples:
    - A mile is greater than a meter in length.
    - Purdue’s ABE program is #1 in the country.
* A subjective premise is one in which there are not agreed upon criteria for evaluating its soundness.
  + Examples:
    - Green is the best color.
    - Biological engineering is better than chemical engineering.
  + Note: self-interest

### Premise Evaluation

* When you create a premise, you should carefully evaluate the soundness of the premise. This may involve careful use of words (Heap of Sand), and evaluation of the type of premise (objective/subjective, inductive/deductive).

### The power of knowledge

* We must have knowledge about an issue to think critically about it.
* There is no substitute for knowledge, information, facts, assumptions, and data in critical thinking.
* Reading, electronic media, etc.
* Must understand the meanings of terms/nomenclature of premises
* Must be able to differentiate between facts and opinions

### Critical Argument Structure: Logic Format

* Logic format involves a sequence of statements which use the concept of equivalence/relationship between ideas/concepts. The ideas/concepts can be expressed by many different types (e.g. words, numbers, pictures, sounds, etc.)
* For example, consider the statements:
  + Premise 1: Men are mammals.
  + Premise 2: John is a man.
  + Conclusion: Therefore, John is a mammal.
* If we replace the concepts of “men”, “mammal”, and “John” by the letters A, B, and C respectively, the statements become:
  + Premise 1: A are B.
  + Premise 2: C is a A.
  + Conclusion: Again, the resulting logical conclusion is C must be the same as B.
* If we express these concepts as numbers, using a mathematical symbol, “=” to replace the words “is” and “are”:
  + Premise 1: A = B
  + Premise 2: C = A
  + Conclusion: C = B

# January 18, 2019

## Deliverable I – Due Today

* [atherton\_deliverable\_i\_submitted.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Project/atherton_deliverable_i_submitted.docx)

## Lecture

* [Critical-Arguments.pptx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Presentations/Critical-Arguments/Critical-Arguments.pptx)

## Critical Arguments

### Logical Fallacies

* Premise 1: women are mammals.
* Premise 2: John is a mammal.
* Conclusion: Therefore, John is a woman.
* This critical argument has the same structure as previously. However, the conclusion is not correct/strong.
  + Why?
* A fallacy is an error in reasoning/logic.
* Types of fallacies
  + Deductive
  + Inductive
  + Circular reasoning
  + Causual
  + Equivocation

#### Deductive Fallacies in Logic

* Example 1:
  + Premise 1: Apples fall from trees onto the ground.
  + Premise 2: I observe an apple on the ground.
  + Conclusion: Therefore, the apple must have fallen from a tree.
* Consequential fallacy – deductive assumption that if A occurs and B results, if B exists then A must have occurred
  + - (Cause-effect)
* Example 2:
  + Premise 1: Kangaroos have a pouch.
  + Premise 2: Kangaroos are mammals.
  + Premise 3: Bob is a mammal.
  + Conclusion: Therefore, Bob must have a pouch.
* Composition fallacy – assumption that something true of a part must be true of the whole

#### Inductive Fallacies

* Example:
  + Premise 1: It usually rains in the evening.
  + Premise 2: It is evening.
  + Conclusion: Therefore, it will rain.
* Probability fallacy – inductive assumption that since something could occur, it is inevitable that it will occur
  + (watch out for words such as most, many, etc.)

#### Circular reasoning/begging the question fallacies

* Premises that are basically the same as the conclusion
* Example 1:
  + Premise 1: The best colors are the ones I like.
  + Premise 2: I like the color green.
  + Premise 3: Green plants and leaves provide shade on hot, sunny days.
  + Premise 4: Green is soothing on the eyes.
  + Conclusion: Therefore, green is the best color.
* Example 2:
  + Premise 1: Joan is an “A student.
  + Premise 2: “A” students do not receive “C” grades
  + Conclusion: Joan should not get a “C” grade in ABE 301.

#### Causual Fallacies

* Assume cause-effect relationships based on temporal sequence or proximity of events
* Example 1:
  + Premise 1: My computer broke yesterday.
  + Premise 2: I did not turn in my homework today.
  + Conclusion: I did not turn in my homework today because my computer broke yesterday.
* Example 2:
  + Premise 1: Crime on campus has risen since last year.
  + Premise 2: There are more left-handed students on campus this year than last year.
  + Conclusion: Left-handed students are criminals.

#### Equivocation

* Defining words as equal to make an argument
* Example:
  + Premise 1: Murder is depriving a living entity of life.
  + Premise 2: Washing your hands kills bacteria.
  + Premise 3: Killing is the action of depriving a living entity of life.
  + Conclusion: Washing your hands is murder.

#### Parallel logic/arguments

* If a critical argument is valid, a parallel argument with the same logic must be valid.
* Example:
  + Argument 1:
    - Premise 1: A = B
    - Premise 2: C = B
    - Conclusion: C = A
  + Argument 2:
    - Premise 1: Women are mammals
    - Premise 2: John is a mammal
    - Conclusion: Therefore, John is a woman
* Note, however, the strength of the conclusion also depends on the soundness of the premises. Note HOS issues and fallacies

### Some common errors

* Do not introduce a new concept/word into the conclusion that was not used in the premises (why?)
* Premises falsely implying “all” of something in reverse, e.g. men are mammals (be alert for implied premises)
* Not including the word “should” in the conclusion (course definition of critical argument)
* Not including all facts/limitations in premises, only giving partial information
* Use of good/bad, right/wrong in premises (moral arguments)

### Extraction of critical arguments

* Look for the word “should” or equivalent at end of prose/article (may be implied)
* Look for related statements of fact/information (numbers, generalizations)
* Look for logical connections between words/statements
* Look for sub-arguments/conclusions (conclusions become premises for larger argument)
* [Analysis of DOI example](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Professor_Notes/Critical-Arguments/declaration-of-independence.docx)

# January 23, 2019

## Declaration of Independence

* Second paragraph
  + Premises of the Declaration of Independence
    - All men have rights that cannot be taken away.
      * Is this sound in all places and contexts?
      * Heap of sand in “all men”
    - Life, liberty, and the ability to do what makes you happy are rights that cannot be taken away.
      * Heaps of sand in “life, liberty, pursuit of happiness”
    - The purpose of government is to protect these rights for its people.
    - The government gets its power from the people it governs.
    - When government does not fulfill its purpose, the people can form a new government.
  + Analysis/Evaluation
    - From where do “inalienable” rights come and how are these related to “human rights”?
    - Why does the U.S. have the “right” to interfere with the actions of other countries (e.g. North Korea, Iran, etc.)? [What is the critical argument?]
    - What is the purpose of governments, i.e. why do they exist?
    - How is the general critical argument applied to King George and the American colonies? How might this be applied to North Korea, Iran, Syria, etc. (parallel arguments)
* Main argument
  + The U.S. should separate from Great Britain and become a free state.

## Analysis of Critical Arguments

* Analysis of a critical argument means to evaluate whether its conclusion is rationally compelling/persuasive. The analysis process involves determining whether the premises of the argument are accurate/true (sound) and whether the conclusion is logically derived from the premises (valid).
* Analysis generally involves:
  + Identify premises/conclusion of a critical argument
  + Examining premises to determine if they are accurate and objective and, if not, to what extent they are subjective or inaccurate.
  + Examining the logic used to derive the conclusion to determine whether it is deductive or inductive and whether any logical fallacies exist.
* Are the terms/words clearly understood defined by the audience?
  + Any heaps of sand?
* Are the premises based on fact or opinion? Are they true for all situations/communities or just for limited situations?
* Is there a clear/logical progression from the premises to the conclusion? Are there any terms/words in the conclusion that are not in the premises? Are there any logical fallacies?
* Example 1:
  + Professor Tao should give all his students “A” grades in this class.
  + Premises:
    - Receiving an “A” grade in this class will help students get a good job.
    - Professor Tao wants his students to succeed and get good jobs.
  + Conclusion:
    - Therefore, Professor Tao should give all his students “A” grades in this class.
  + Premise 1:
    - Probability – inductive
  + Premise 2:
    - Heaps of sand weaken premise
    - Inductive – “wants”
  + Implied premise:
    - Dr. Tao should do what he wants.
  + Conclusion:
    - Logical
  + Heaps of sand
    - Help
    - Good
    - Wants
    - Succeed
    - Give
    - All
  + Neither valid nor sound; both premises are highly inductive/subjective
  + Particularly note “and” in premise 2, which links irrelevant term “success” to “good”
* Example 2:
  + Gencyclovir will help manage cancer symptoms in elderly adults.
  + Premises:
    - Gencyclovir has been proven in clinical tests to help manage cancer symptoms in rats.
    - Rats are mammals.
    - Elderly adults are mammals
  + Conclusion:
    - Therefore, Gencyclovir will help manage cancer symptoms in elderly adults.
  + Not a critical argument (informational)
  + While the premises are true, logic that all mammals are the same is not correct (fallacy of equivocation)
  + Heaps of sand
    - Proven
    - Help manage
    - Elderly
  + Note how conclusion gets around Heap of Sand issues by using same language (“help manage” and “elderly”). Removes need to define term with respect to the argument, but may weaken conclusion/argument
* Example 3:
  + Premises:
    - China has the largest population in the world
    - All people require goods and services
    - Successful business means selling large amounts of goods and services
    - The selling of goods and services requires effective communications
    - Speaking the same language is required for effective communications
    - Chinese is the language spoken by the people of China
  + Conclusion:
    - Therefore, to be successful in business, one should learn to speak Chinese
  + Valid, but note that premises 3 and 4 are highly inductive/subjective and tend to weaken the conclusion
    - Premise 5 is not sound
    - Premise 6 is a composition fallacy
  + Heaps of Sand
    - Largest
    - All
    - Large
    - Effective

# January 25, 2018

## Complex Modeling Homework – Due Today

* [complex-modeling-problem.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Homework/complex%20modeling%20problem.docx)
* [atherton\_homework\_complex\_modeling.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Homework/atherton_homework_complex_modeling.docx)

## macandcheesefaceA Visual Critical Argument

* Look at the image and analyze the argument being made
  + **Identify the conclusion--action**
  + Identify the premises
* Premises
  + Kraft makes genetically engineered foods. *Sound*
  + Eating/purchasing genetically engineered foods pose risks to our health and the environment. *Assuming average consumer thinks this is sound*
  + Eating/purchasing foods that pose risks to our health and environment are bad actions. *Bad (defining as self-interest) is a heap of sand, inductive; Sound*
  + Kraft macaroni and cheese contains genetically engineered foods. (picture) *Sound*
  + Children are frightened by Kraft macaroni and cheese (picture).
  + Kraft does not care about posing risks to our health and the environment or about frightening children.
  + Purchasing/eating foods that frighten children is a bad action. *Sound*
  + (We should not act badly.)
* Conclusion
  + Therefore, we should not eat or purchase food from Kraft.
    - Kraft is a food company whose purpose is to make money
    - Kraft makes genetically engineered foods
    - Kraft poses a risk to health and environment
    - Kraft does thing that are bad for our self-interest
    - Mac and cheese is genetically engineered food
    - Children are frightened by Kraft
    - Kraft doesn’t care about performing bad actions.
    - We should not purchase Kraft foods

## Movement and Sound

* Commercials are the most powerful form of critical arguments
* Conclusion is usually “buy my product”
  + Can you analyze and understand the argument?
  + Can you rationally understand the argument?
  + Can you identify irrational arguments?
* John West Salmon Commercial
* Life Insurance Company
  + Buy life insurance
  + Use humor to say “expect the unexpected”, introduce the topic of life insurance which is kind of a morbid idea
  + Without sound, not as effective
    - Words address rational behavior
    - Music can make commercials memorable
    - Sounds appeal to emotions of audience

# January 28, 2019

## Take-Home Quiz 3 – Due Today

* [3-synthesis.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Quizzes/Take_Home_Quizzes/Problems/3-synthesis.docx)
  + [3-background1.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Quizzes/Take_Home_Quizzes/Problems/3-background1.docx)
  + [3-background2.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Quizzes/Take_Home_Quizzes/Problems/3-background2.docx)
  + [3-background3.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Quizzes/Take_Home_Quizzes/Problems/3-background3.docx)
* [atherton-take-home-quiz-3.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Quizzes/Take_Home_Quizzes/My_Solutions/atherton-take-home-quiz-3.docx)

## Review of Take-Home Quiz 2

* [Atherton-Take\_Home\_Quiz\_2.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Quizzes/Take_Home_Quizzes/My_Solutions/Atherton-Take_Home_Quiz_2.docx)

# January 30, 2019

## Deliverable 1 – Due Today

* [atherton\_deliverable\_i\_submitted.docx](https://d.docs.live.net/a6815758e2b5dbf9/ABE_301/Project/atherton_deliverable_i_submitted.docx)

# February 1, 2019

## Synthesis of a Critical Argument

* Creating a critical argument is generally much more difficult than analyzing a pre-existing argument.
* The primary synthesis skills involve:
  + The ability to clearly, objectively state the premises and the ideas/concepts contained in the premises (soundness). This involves a good command of the medium used to express the ideas, e.g. writing, creating images, sounds, etc.
  + The ability to construct valid logical relationships between the premises and the conclusion

Critical Argument Development

* What is the desired conclusion? (Generally, a prescribed action/decision, i.e. you should do X)
* What are the assumptions/premises?
  + Premises must be stated clearly and unambiguously (agreed upon word definitions, soundness)
  + Premises must logically lead to conclusion (logic, validity)
  + Be sure to include a premise involving action/decision
* Example:
  + Desired conclusion: Dr. Tao should give all ABE 301 students a grade of A.
  + Premises
    - Having better job opportunities is beneficial for students
    - Students with high grades have better job opportunities
    - A grade of “A” is a high grade
    - One of Dr. Tao’s actions is to give students grades in ABE 301
    - (Dr. Tao’s actions should benefit students)
  + Conclusion
    - Therefore, Dr. Tao should give all ABE 301 students a grade of A

### Purpose

* When you are a professional manager and want to make a decision/action, i.e. what project to fund, how to convince boss to give you a raise, whether to take a promotion, etc.
* Use critical thinking/analysis skills to develop/analyze arguments to persuade or evaluate

### Social/Political/Technical Context

* Recently, a Chinese bioengineer reported genetic alteration of humans to prevent HIV. As a biological engineer, should you conduct research on genetic alteration of humans to improve social welfare?
* If you were the CEO of a large multinational food/pharma company, should you conduct business with wealthy countries who assassinate their citizens?
* As a biological engineering student, should you take a high-paying job with a company that sells food products containing carcinogenic-linked ingredients?

## Arguments vs. Models: Parallel structure

* Arguments
  + Knowledge
    - Inductive/deductive
  + Premises
    - Accuracy/truth
    - Heap of Sand
  + Conclusion
    - Logical construction
  + Behavioral change/decision
* Models
  + Knowledge
    - Theory/observation
  + Assumptions
    - Accuracy/precision
    - Definitions
  + Model
    - Logical construction (mathematical)
  + Application/Utility decision
* Same critical analysis/thinking skills needed for both

### Differences/Similarities

* Same critical analysis/thinking skills needed
  + Premises/assumptions
  + Logical construction to conclusion/model
* Different knowledge set (maybe)
  + Science/mathematics vs. political/economic
  + Behavioral biology/biological engineering (!)
* Quantitative/deductive vs. qualitative inductive
  + Mathematics vs. experience/culture
* Same outcomes (maybe)
  + Both used to make decisions, change behavior
  + Process of argument/model improvement
  + Issue of reproducibility in different situations

## Critical Arguments in Commercials

* Not all critical arguments are purely rational
* Balance between receiver and synthesizer
  + Synthesis is always rational
  + Can be “insulting” to receiver

### ETrade Monkey

* “give us your money”
* Sound made the commercial seem more dysfunctional

### Mazda – Parking

* “buy our product”
* Mazda cars are easy to drive in difficult situations
* Mazda cars empower women
  + Women are mocked by men

### Budweiser

* “buy our product”
* Budweiser connects men
* Watching football
* African American men
* Referencing a movie
* Interesting, relational, cool
* Cultural stereotypes
* Motto – trust us
* Humor
* Irrational
* Popular dog breed
* Started in a party
* Aliens = Budweiser is for everyone
* Technology = Budweiser is for smart people, powerful people

# February 4, 2019

## Finding the Zero of a Function

* Bisection method
* Newton-Raphson method
* Regula falsi method

# February 6, 2019

## Practicing the Root-Finding Functions

* [roots\_in\_class](Codes/roots_in_class_020619.mlx)

# February 8, 2019

## Cubic Splines

# February 11, 2019

## Take Home Quiz 4 Due Today

[takehome\_quiz4.pdf](Quizzes/Take_Home_Quizzes/My_Solutions/atherton_takehome_quiz4.pdf)

[quiz4.mlx](Quizzes/Take_Home_Quizzes/My_Solutions/atherton_quiz4.mlx)

## Review of Root-Finding