A Summary of IST 402 (Week 14)

- **AI and Multiagent Systems for Social Good**
    - **Big Question & Key Challenge**

How can we optimize our limited intervention resources when we are interacting with other agents?

- Public Safety and Security
- Conservation
- Public Health

- **Optimizing Limited Intervention Resources**
    - Public Safety and Security
        - Game Theory for Security Resources Optimization
        - Real-world: US Coast Guard, US Federal Air Marshals Service
            - i.e. African Countries: Ghana, Uganda'
    - Public Safety and Conservation
        - Security games and adversary
        - Green security games
        - Intelligent patrol patterns
            - Real-world: Parks
                - i.e. Zambia, Mozambique
    - Public Safety and Conservation

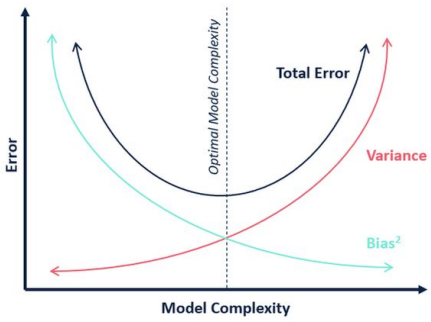
- **Overall Research Process**
    - **Immersion** → data collection
    - **Predictive model** → learning/expert input
    - **Prescriptive algorithm** → game theory intervention
    - **Field tests** → deployment

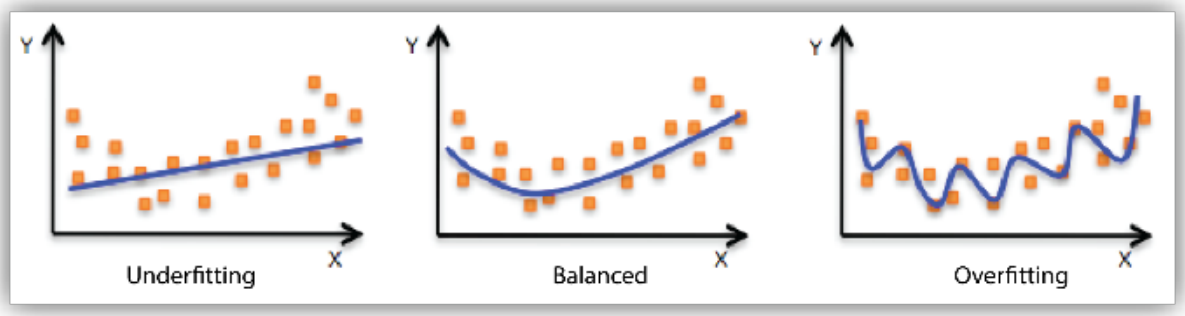
- **Game Theory for Security Resource Optimization**
    - Based on Stackelberg Security Game
        - Stackelberg Example: Defender commits to randomized strategy, adversary responds
            - shows a strategy and game can be as complex as you want
            - For simplicity, numbers are determined by surveillance, etc.
    - Optimization: Not 100% security (i.e defender would always win), increase cost/uncertainty to attackers
        - Can't guarantee 100% security due to limited resources
    - Real-World: ARMOR at LAX [2007], IRIS for Federal Air Marshals Service [2009]

- **Why don't Countries use Machine Learning (ML)?**
    - Simply do not have enough data
        - Countries do not have enough data as they don't face frequent breaches

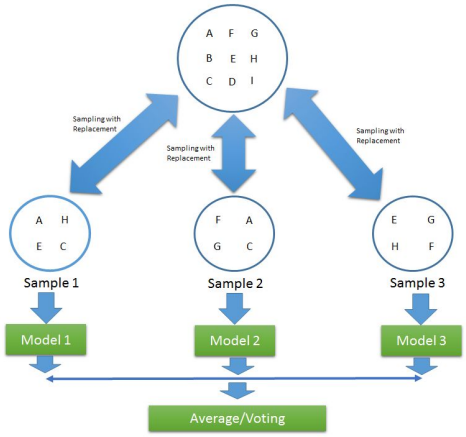
Semester Recap

1. **Key Takeaways**
    a. AI has blossomed into one of the biggest fields in computer science
        i. Led by AI and ML
        ii. More data - big data
        iii. Better computing power
2. **AI Trajectory: Valid Concerns**
    a. People: Elon Musk, Bill Gates, Stephen Hawking
        i. Fake news generator (recently been released)
    b. AI Chatbot that was discovered to be racist
    c. Facebook tagged two people as gorillas among AI discrimination issues
    d. AI Discrimination amongst employee hires
        i. **… BUT ...**
    e. Despite these issues, AI still has enormous potential to help underserved people
    f. Course has been exercise in making you believe in vision
    g. Numerous applications of how humanity can be helped through the use of AI
3. **What cool techniques did we learn…?**
    a. Train, validation, test (supervised learning)
        i. Training set is a set of examples used for learning a model
        ii. Validation set is a set of examples that cannot be used for learning the model but can help tune model parameters
            1. Need a validation set to figure out what parameters should be used in your model
            2. Helps control overfitting
        iii. Test set is used to assess the performance of the final model and provide an estimation of the test error
            1. Results on the testing set are the only results that matter for final product
        iv. NOTE: Never use the test set in any way to further tune the parameter or revise the model
    b. Decision Trees
4. **Training and Testing**
    a. Underfitting - High bias
    b. Overfitting - High variance
    c. Bias Variance Tradeoff



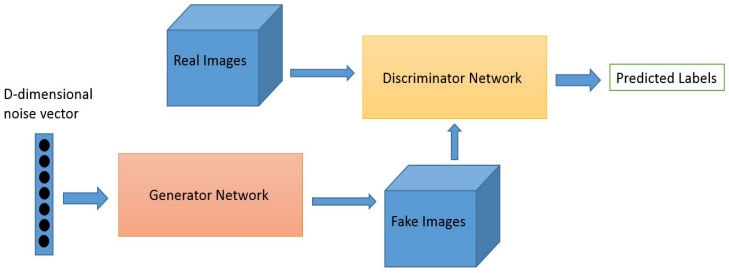


5. **Evaluation Metrics**
    a. Predicted labels
        i. 2 options: Positive or Negative
        ii. The predictive and the actual labels can be either positive or negative
6. **Bagging**
    a. More evolved version of a decision tree
        i. Essentially create multiple decision trees
    b. After making all the decision trees, the decision that you will make will be the average of all the decision trees
    c. Use an average model as the final model



7. **Prisoner's Dilemma**
    a. Rational way of solving: it is always optimal to defect
    b. In rational play, both players will choose to defect
8. **Nash Equilibrium**
    a. It is suboptimal for each player to deviate from their strategies, if the other play continues to play the same strategy
        i. Given they are at equilibrium
        ii. Every finite game has a nash equilibrium
9. **Stackelberg Game: Non-simultaneous moves**
    a. One player is a defender - They move first
        i. Must commit to random strategy
    b. Other player is the adversary - They move after the leader
        i. Responds to random strategy
    c. Not 100% security - optimizing chances based on limited resources
10. **Deep Learning**
    a. Neural Networks
    b. Backpropagation algorithm

c. Different kinds of Neural Networks
    i. Vanilla deep nets - numeric data
    ii. Convolutional neural networks (CNN) - image data
    iii. Generative adversarial nets (GAN) - create data
    iv. Recurrent neural nets (RNN) - sequentially structured data (text, videos,etc.)



11. **More than Accuracy…**
    a. Interpretability - Medical community
    b. Fairness - COMPAS
    c. Ethics - Self-driving cars
    d. Machine application for social good - predicting childhood influenza