MAT 202 - Probability and Random Processes

Lecture - 1

AHMEDABAD UNIVERSITY | School of Engineering and Applied Science

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Information and Communication Technology (ICT),
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January 2, 2019

Outline

- **MAT 202: General Course Information**
  - Team
  - Website and Piazza Discussion
  - Schedule
  - Grading

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- **Why should we learn MAT 202?**

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- **Engineering Applications:**
  - Speech Recognition System
  - Radar System
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  - Daily Life conversations
- **Engineering Applications:**
  - Speech Recognition System
  - Radar System
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MAT 202: General Course Information

- Team

1. **Dr. Dhaval Patel**
   - Role : Instructor
   - Place: Faculty Office (Room-239)
   - Faculty Profile: `https://ahduni.edu.in/seas/people/faculty/dhaval-patel`
   - Area of Interest: Cyber Physical System, Wireless communications, Spectrum Data Analytics, (Vehicular Networks, Non-parametric statistics, mm-Wave xG network, Chemical Communication, Physical Layer Security)
   - Email: `dhaval.patel@ahduni.edu.in`
2. **Not Defined**
   - Role: TA - Tutorial, Assignment Evalution, Query Solving etc.
   - Brijesh-JRF (DST-UK), Sagar - JRF (DST-ASEAN), Research Engineers (ICT / Chemical /Mechanical)

MAT 202: General Course Information

- Website and Piazza Discussion

Course Website

`https://piazza.com/ahmedabad_university/winter2019/mat202/home`

Piazza !

Why to use Piazza!

1. To build your Confidence level
2. Collaborative Learning
3. Feedback on lecture session
4. Personal Communication with Instructor/TAs
5. Group discussion: Special Assignment
6. Put your thoughts on paper: Leads you towards Effective Communicator

MAT 202: General Course Information

- Schedule

Lecture Sessions:Room-107: Instructor

1. 11.00 p.m to 12.30 p.m (Monday,Wednesady)
2. 1.00 p.m to 2.30 p.m (Tuesday)

MAT 202: General Course Information

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Lecture Sessions:Room-107: Instructor

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Tutorial Sessions: Room-107 : Instructor/TA

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MAT 202: General Course Information

- Schedule: For the Current Week

Timing for the Discussion and Difficulty Sessions: Instructor

1. Contact Hours: 24x7 through Piazza and In person - Anytime (Time Limit : 5-7 minutes max)
2. Best Practice: Put your queries on Piazza !
3. Need more time: Feel free to write on office email

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Important Note:

1. LaTex Tutorial and Assignment Submission Guideline [Jan 7 - Jan 11]

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- Grading

Grading Policy:

1. Semester End Exam: 40 %: 2 Hours exam: 40 Marks
2. Mid Semester Exam: 20 %: 2 Hours exam: 30 Marks
3. Homework Assignments: 15% Problem solving: Total five – Due at every 14 days)
4. Special Assignment:25 %: Report submission and Presentation: Modeling of uncertinity in Life Science (Biology) / Chemical / Mechanical only(Modeling, Coding and Problem Solving)

MAT 202: General Course Information

- Library Resources

Text Book

1. Scott Miller and Donald Childers. Probability and random processes: With applications to signal processing and communications. Academic Press, 2012.
   [Rs. 460-480 at Amazon] [Library Copies:10]

References:

1. Bertsekas, Dimitri, and John Tsitsiklis. Introduction to Probability. 2nd Ed. Athena Scientific, 2008.
2. Grimmett, Geoffrey, and David Stirzaker. Probability and Random Processes. 3rd Ed. Oxford University Press, 2001.
3. Papoulis, A, and S. U. Pillai (2002), Probability, Random Variables and Stochastic Processes, 4th Ed., TMH.
4. A first Course in Probability, Sheldon Ross, 9th Edition, Person 2012.

MAT 202: General Course Information

- Library Resources (Continue..)

Video Lectures

1. http://nptel.iitm.ac.in/courses/111102014/
2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-041-probabilistic-systems-analysis-and-applied-probability-fall-2010/video-lectures/

Why should we learn MAT 202?

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Conversations between Patient's Relative and Nurse

A patient is admitted to the hospital and a potentially life-saving drug is administered. The following dialog takes place between the nurse and a concerned relative.

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NURSE: Each case is different, we have to wait.

(3) RELATIVE: But let's see, out of a hundred patients that are treated under similar conditions, how many times would you expect it to work?
NURSE (somewhat annoyed): I told you, every person is different, for some it works, for some it doesn't.

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Conversations between Patient's Relative and Nurse

A patient is admitted to the hospital and a potentially life-saving drug is administered. (Continue..)

(4) RELATIVE (insisting): Then tell me, if you had to bet whether it will work or not, which side of the bet would you take?
NURSE (cheering up for a moment): I'd bet it will work.

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NURSE (cheering up for a moment): I'd bet it will work.

(5) RELATIVE (somewhat relieved): OK, now, would you be willing to lose two dollars if it doesn't work, and gain one dollar if it does?
NURSE (exasperated): What a sick thought! You are wasting my time!

Why should we learn MAT 202?

- Conversational analysis

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NURSE: I hope it works, we'll know tomorrow.

(2) RELATIVE: Yes, but what is the probability that it will?
NURSE: Each case is different, we have to wait.

- In this conversation, the RELATIVE attempts to use the Concept of Probability to discuss an Uncertain Situation.
- The nurse's initial response indicates that the meaning of "probability" is not understood
- The RELATIVE tries to make it more clear

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- The approach is to define probability in terms of **Frequency of Occurrence**, as a % of successes in a moderately large number of similar situations.

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- The approach is to define probability in terms of **Frequency of Occurrence**, as a % of successes in a moderately large number of similar situations.
- However, Nurse is not wrong:
  What if this was an experimental drug that was administered for the very first time in this hospital or in the nurse's experience?

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- It is an attempt to infer the nurse's beliefs in an indirect manner.
- Since the nurse is willing to accept a one-for-one bet that the drug would work, we may infer that the **Probability of Success is judged to be at least 50%**.

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(5) RELATIVE (somewhat relieved): OK, now, would you be willing to lose two dollars if it doesn't work, and gain one dollar if it does?
NURSE (exasperated): What a sick thought! You are wasting my time!

- If the nurse has accepted the last proposed bet (two-for-one), this would have a **Probability of Success at least 2/3**.

Why should we learn MAT 202?

Probability theory is an extremely useful tool
(Based on empirical evidence)

- A broad variety of contexts can be visualized
- Successful applications in science, **Engineering**, medicine etc
- Non-engineering applications: CASINO (Game of Chance), Insurance Industry, Meteorologist

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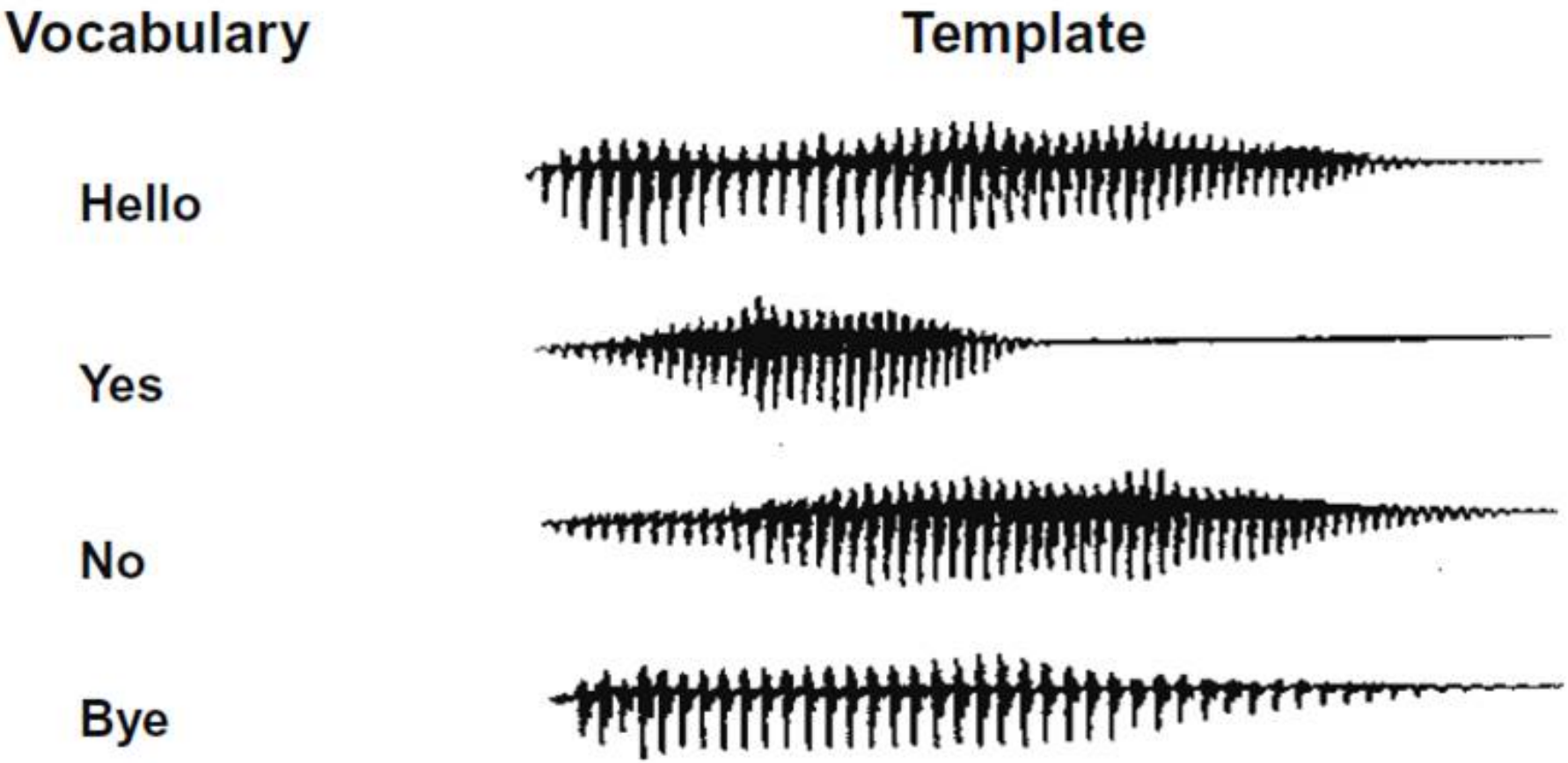
Key Objectives and Outcomes for MA-202:

- To develop the art of **describing uncertainty** in terms of probabilistic models
- To describe the **generic structure of probabilistic models** and their **basic properties**
- Learn PRP as a tool to understand core engineering application
- **Important Engineering Applications:**

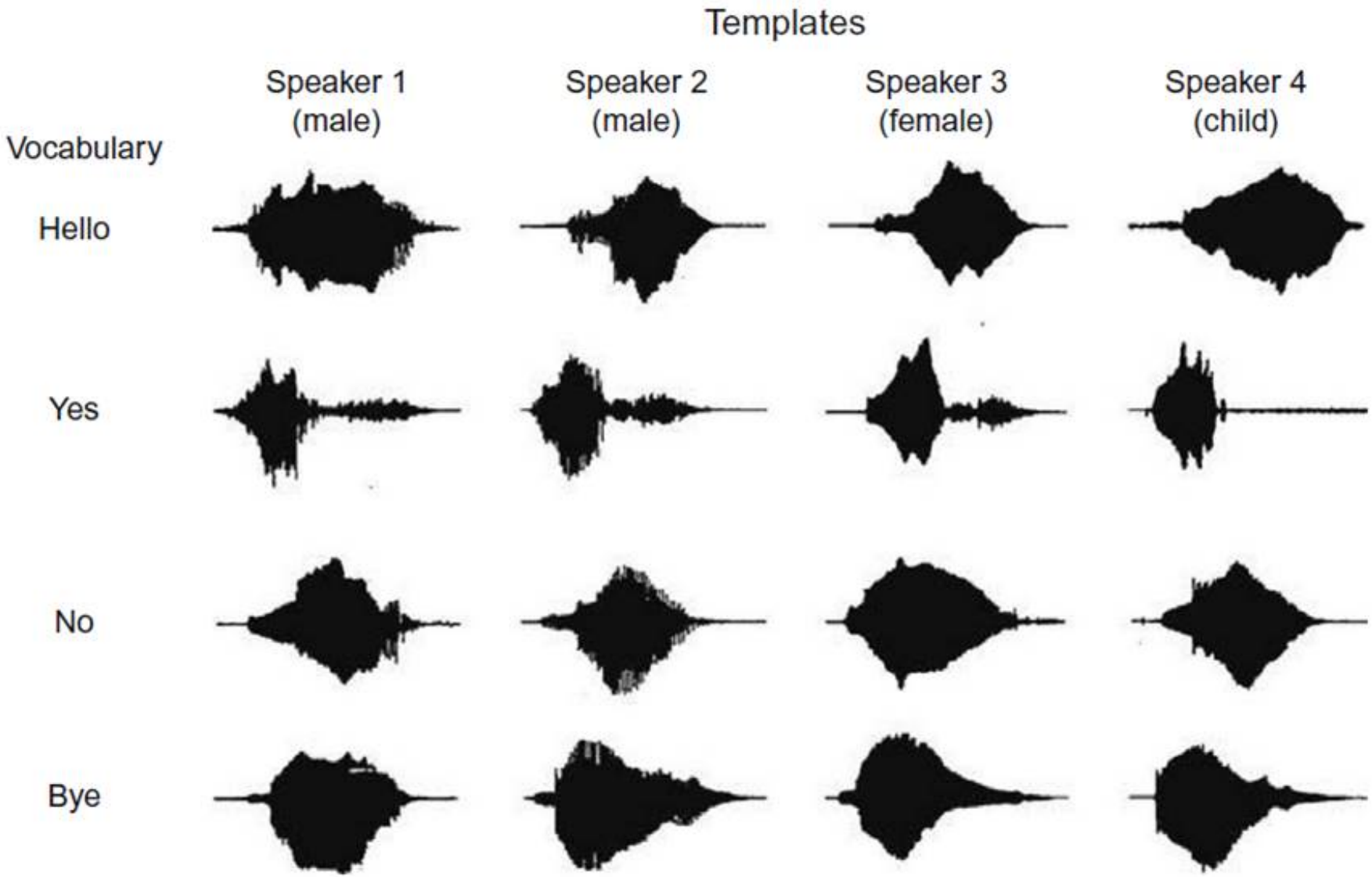
Engineering applications

- 1. Speech Recognition System (1/2)



Engineering applications

- 1. Speech Recognition System (2/2)



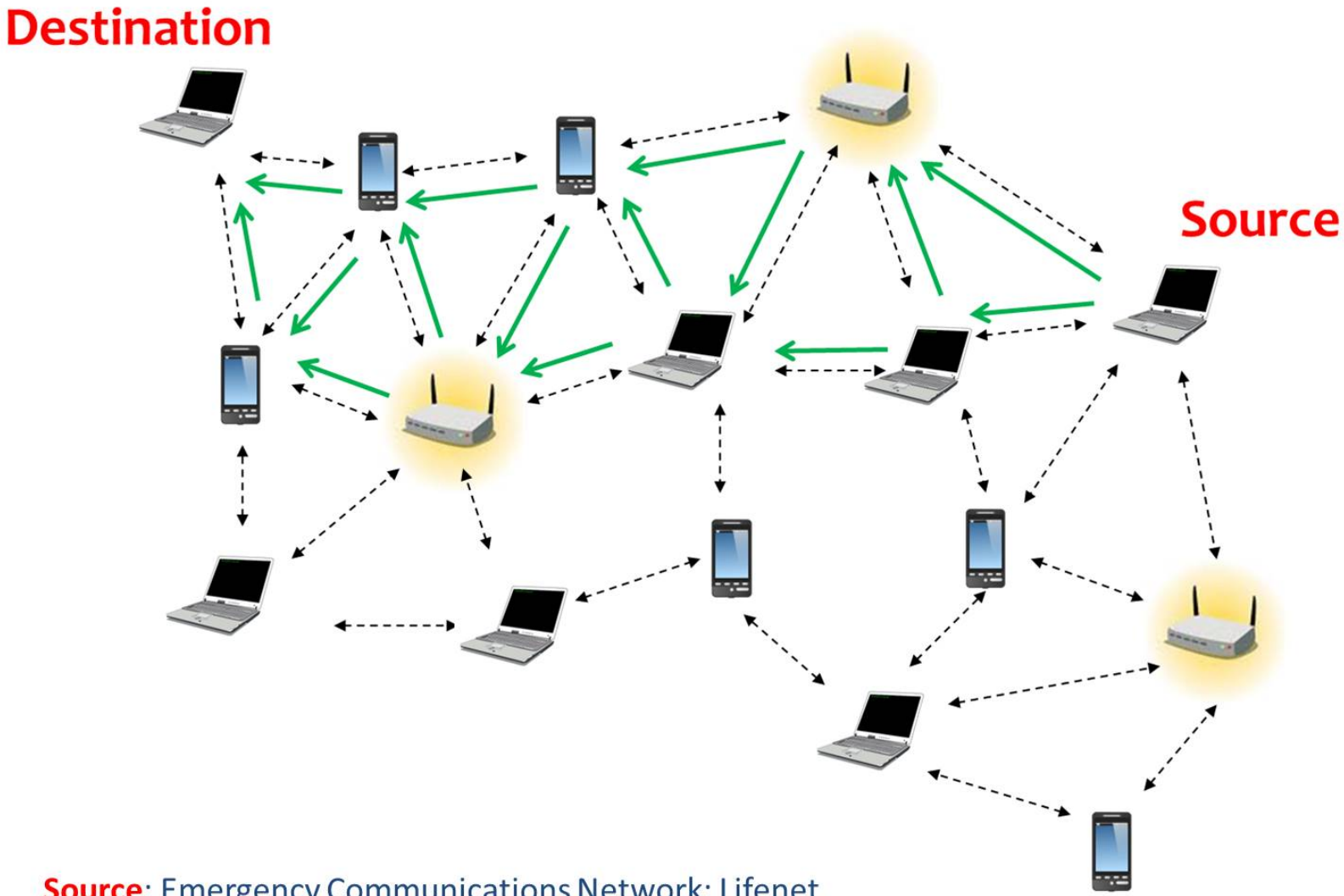
Engineering applications

- 2. Radar System

Source: http://www.ktm2day.com/2011/01/12/tia-13-yr-old-radar-still-out-of-order/

Engineering applications

- 3.Communication Network



Source: Emergency Communications Network: Lifenet

Thank you