



Introduction to Telecommunications

ECE 3710 – Spring 2026

JC Williams – Adjunct Faculty and Ph.D. Student

Electrical and Computer Engineering

Outline

- Instructor Information
- Course Syllabus
- Questions?
- **Modern Communication Systems: An Overview**
 - A Little History
 - Communication System Overview
 - Analog vs. Digital System

Instructor Information

JC Williams (Wireless Power, Adaptive Control Systems, & Antenna Design)

- **Email:** jcwilliams@tntech.edu (Don't be afraid to reach out – I'll respond ASAP)
- **Office Hours:** PRES 449 (or PRES 120) 9:00 am to 11:00 am (F), others by appointment
- **Unavailable (Mostly):** Also teaching MECH from 2:00 pm to 10:00 pm M, T, and W
- **Experience:** US ARMY Space Com. & Radiance Tech. (RADAR, HPM, and HEL)



Syllabus: Course Overview

- **Modern Communication System: An Overview (Today)**
- **Signal Processing (~15%)**
 - Fourier Series/Transform: A Review
 - Signal, Power/Energy Spectral Density
- **Analog Communication System (~35%)**
 - Amplitude Modulation (DSB, SSB)
 - Angle Modulation (FM, PM)
- **Digital Communication System (~30%)**
 - Analog/Digital Conversion (Sampling, Quantization, PCM)
 - Digital Modulation (ASK, FSK, PSK)
- **Information Theory: A Brief Review (Source/Channel Coding) (~20%)**

Syllabus: Textbook and Instructional Platform

- **Textbook:** **Modern Communication Systems: A First Course**, Todor Cooklev & Andrew Yagle, Michigan Publishing Services, 2024. A printed version and a free PDF are available at <https://services.publishing.umich.edu/Books/M/Modern-Communications-Systems>.
- **Supplement Materials:** **Principles of Modern Communication Systems**, Samuel Agbo & Matthew Sadiku, Cambridge Press, 2017. ISBN: 978-1-107-10792-2. Slides, handouts, extra problems, and solutions will be posted regularly on the course website (**ILearn**).
- **Other Instructional Platform:** GNU Radio set – the **RTL-SDR kits** are available for lending.
 - **Kit Check Out:** See Mrs. Julie Mountain in Brown 217-A (bring your Eagle Card).
 - **It is your responsibility to keep the kits in good shape and return them by the due date!**

Syllabus: Teaching Methods

- **Lectures** – **Lectures** will be delivered **in-person**.
 - A clean version and annotated version of the lecture slides will be uploaded to **ILearn**.
- **Homework** – Assignments will be posted on **ILearn (submit as PDF by due date)!**
- **Quizzes** – **Attendance** will be kept using **in-class quizzes (announced ahead of time)**.
- **Projects** – GNU Radio kits (and other given items) will be used for hands-on projects.
- **Exams** – **Two short Exams** will be given in the semester, in replace of the Midterm.
- **Final Exam** – **The Final Exam will be Wednesday, May 6th, from 10:30 am to 12:30 pm.**

Syllabus: Workload and Grading

- **Quizzes (5% of Total Grade)**

- **Attendance** is checked by **short, in-class quizzes** (these are a great study tool for exams)!
- The **two lowest** quizzes grades will be **dropped**, **but you are required to attempt all quizzes**.

- **Homework Assignments (20% of Total Grade):**

- There are **5** homework assignments (**4% each**).
- The **lowest** homework grade will be **dropped**, **but you are required to attempt all assignments**.

- **Projects (25% of Total Grade)**

- There are **4** projects (**6.25% each**) given for hands-on activities (GNU, MATLAB, & AM Radio).

- **Exams (25% of Total Grade)**

- **2** short Exams (**12.5% each**) will be given in place of a Midterm.

- **Final Exam (25% of Total Grade)**

- The Final Exam will be **in-class** on **Wednesday, May 6th, from 10:30 am to 12:30 pm**.
- **Thursday, April 30th** will be an **in-class review session** where we cover example problems.

Important Dates ~ **Tentative** Schedule

- Exam 1 – In Class – **Tuesday, February 17th, from 12:00 pm to 1:15 pm.**
- Exam 2 – In Class – **Tuesday, April 7th, from 12:00 pm to 1:15 pm.**
- Review for Final Exam – In Class – **Thursday, April 30th, from 12:00 pm to 1:15 pm.**
- All Assignments Due (Anything Not Submitted is a 0) – **11:59 pm on Thursday, April 30th.**
- All Grades (Excluding the Final Exam) Visible in Ilearn – **11:59 pm on Sunday, May 3rd.**
- Final Exam – In Class – **Wednesday, May 6th, from 10:30 am to 12:30 pm.**

Syllabus: Course Policy

▪ Student Academic Misconduct:

Unless stated otherwise, all assignments, projects, and quizzes are individual efforts.

- ✓ Homework Assignments: Individual efforts, **discussions are allowed**, **but do not submit the same content!**
- ✓ Projects: Can be group work (max 2 students per group), however, **need to clarify each group member's responsibility**.
- ✓ Exams: Two-page equation sheets and in person **(no internet and no electronic devices allowed – except for approved calculators)!**
- ✓ Final Exam: Two-page equation sheets and in person **(no internet and no electronic devices allowed – except for approved calculators)!**
- ✓ Calculators: See <https://ncees.org/exams/calculator> for the list of approved calculators.

Syllabus: Course Policy (Cont.)

- Attendance and Participation Policy:
 - You are expected to attend every lecture and hands-on session.
 - It is your responsibility for any material covered during class meetings!
- You should be aware of the following University policies:
 - Academic Misconduct (TTU Policy 216, Student Academic Misconduct).
 - Patents and Copyrights (TTU Policy 732, Intellectual Property).
 - Generative AI resources are allowed to be used for **specific homework and project assignments** and **within set parameters**, as **designated by the instructor**.
 - See course syllabus for citation requirements – I support the responsible use of AI Tools!



Intro – What is Telecommunications?

- **Telecommunications:** Distant connection or transfer of meaningful **information** from one location to another
- Different methods of **information transfer** make the world always “on”

❖ Application 1: Radio stations



❖ Application 2: Smart Home/Grid



❖ Application 3: Autonomous Driving



Why ECE 3710?



✓ Because I can get a job easily!

- The recent boost in next-gen & satellite communication
- Space Command, NGA, Denso, Qualcomm, Broadcom, TI, etc.

✓ Because I can go to that course!

- ECE 4710 (Principles of Telecommunications)
- ECE 6710 (Communication Systems Theory)



✓ Because I want to do the research!

- Growing research areas on next-gen communication
- Interdisciplinary areas: Smart Grid, Internet-of-Things, Autonomous Driving, & Edge Comp.

✓ Just because!

- Personal Interests: Societal Impact? Crucial Public Infrastructure
- The Sorcery of Electrical and Computer Engineering!



The History

Marathon
Origin



490BC

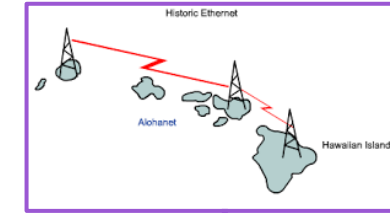
Electric
Telegraph



Amplitude Modulation
Radio Broadcast



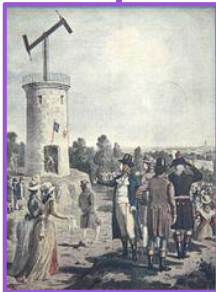
AlohaNet



Name one modern communication systems
we use today?

71

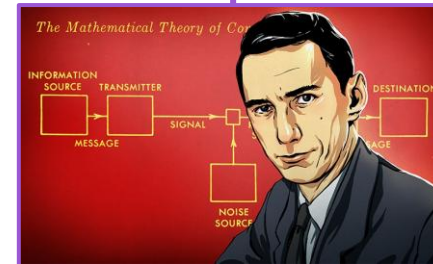
Now



Semaphore
Telegraph



Telephone
by Bell



Concept of Cellular Proposed;
Shannon: Information Theory



Social Media & WEB

The World of Telecommunication Now

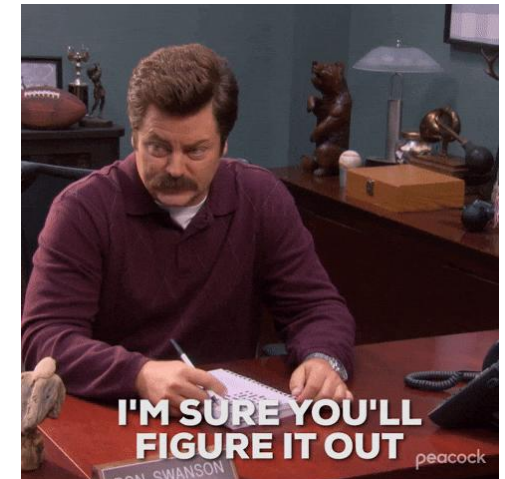
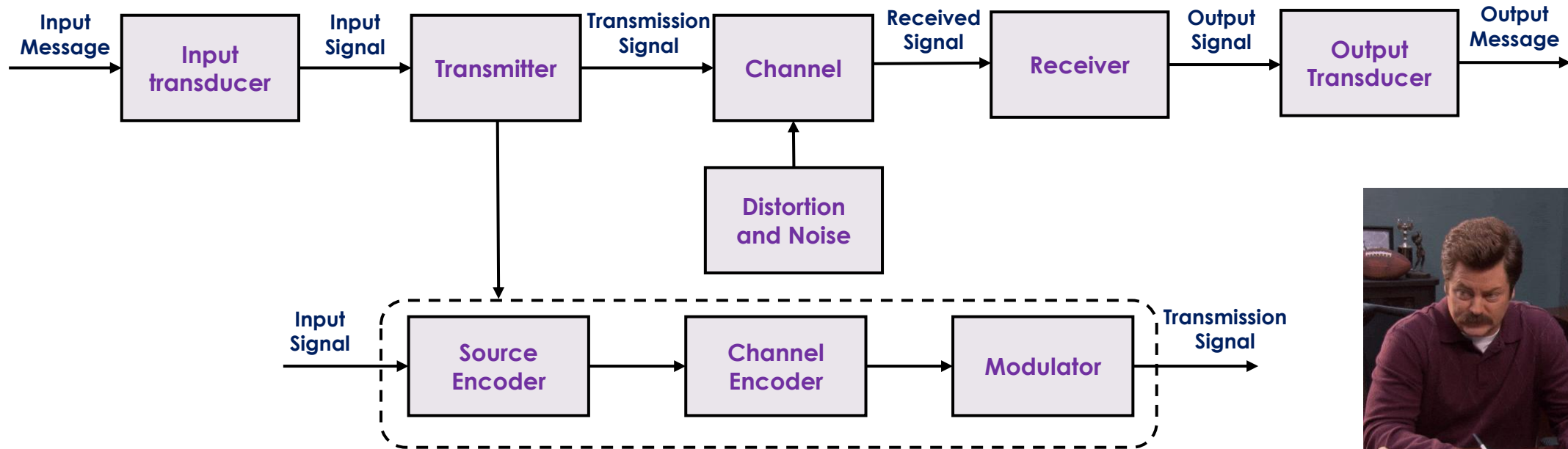
- ❑ Radio Broadcasting (FM, AM)
- ❑ Computer Networks (LAN, WAN, and Ethernet)
- ❑ Satellite Systems (Military and Commercial)
- ❑ Cellular Networks
- ❑ Bluetooth
- ❑ ZigBee (Smart Home)
- ❑ GPS (Phone and Automobile)

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For Human/Machines to Communicate, What are the Basic Components?



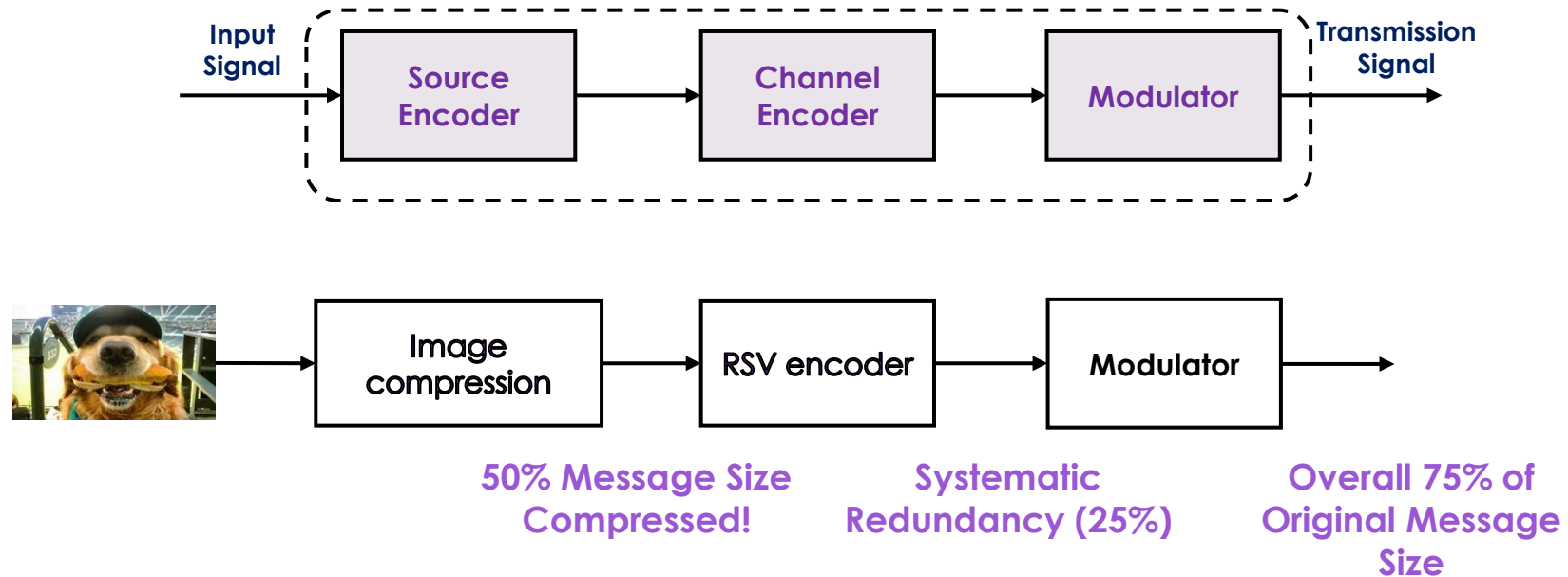
Communication System Block



Transmitter:

- **Source encoder:** Input Signals → Information Bits (**Data Compression**)
- **Channel encoder:** Information Bits → Information Waveform (**Add Redundancy**)
- **Modulator:** Information Waveform → Transmission Signal

Source Encoder & Channel Encoder



How Does Redundancy Enable Error Correction?

Let's say we transmit a sample that is combination of four binary digits 0001, 0010, 0011,.... (16 combinations)

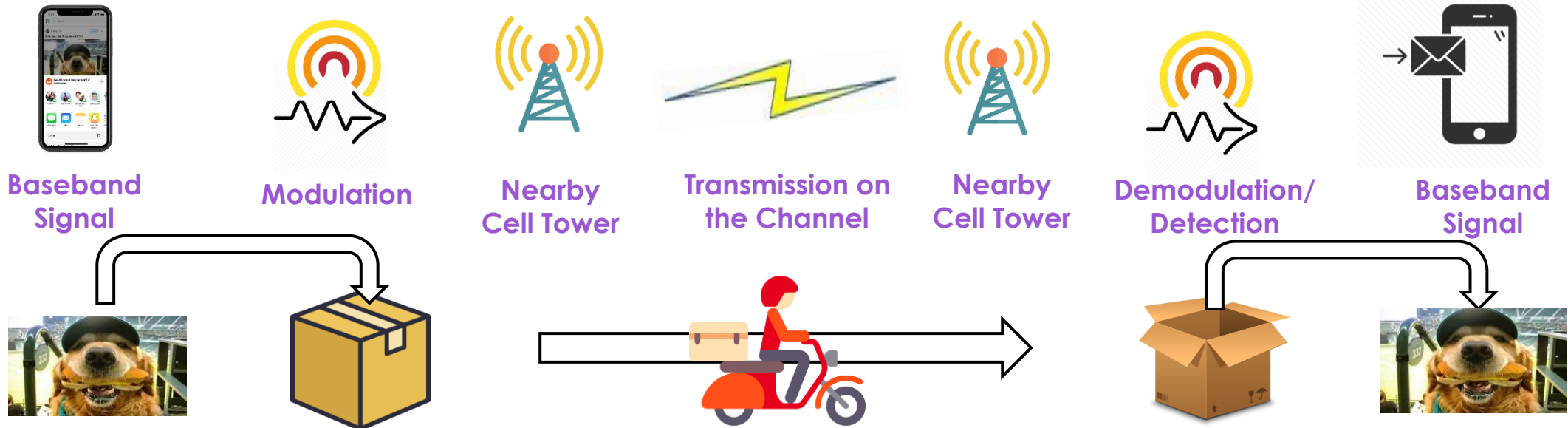
Add a Fifth Pulse to Make the Number of Positive Pulses Even
00011,00101,00110,....

When a Single Error Occurs, It Can be Detected!

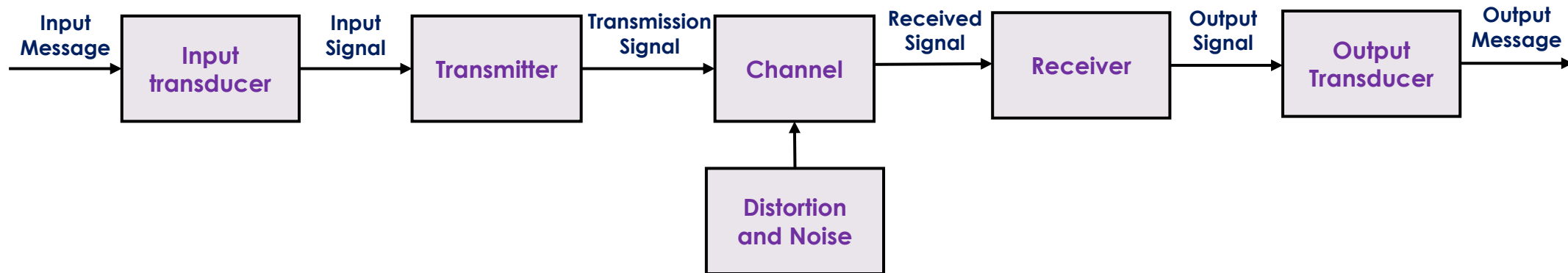
Modulation: The Santa Dilemma



Even Santa Cannot be Heard Over a Long Distance...
Also, He Lives in the North Pole...

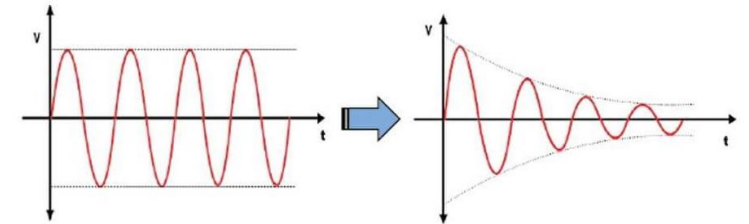


Communication System Block (Cont.)



Channel: The physical medium used to transmit the signal (attenuates and distorts the transmitted waveform)

- Radio Channel: Convey Electromagnetic Waves (20kHz to 20+GHz)
- Copper Wires (Telephone & DSL); Optical Fiber; Coaxial Cable (television)



Attenuation, Distortion, and Noise

- **Attenuation**: The decrease of signal strength (proportional with the signal travelling distance)
- **Distortion**: Due to physical phenomena such as frequency-dependent gains and doppler shift
- **Noise**: Corrupts the transmission signal along the path and is mostly random (we always filter)!

Analog vs. Digital Message

▪ Analog Message

Values vary **continuously**, over a **continuous** time range

- A recording of your favorite song
- AM/FM for the sound

Analog Signal



▪ Digital Message

Value **limited** to a **finite set** and usually ordered combinations of **finite** symbols

- Morse-Code Telegraph (Binary)
- Your Grade (M-ary)

Digital Signal



Question Time!

What kind of message is an English text document?

Digital! It consists of combinations of 26 letters, 10 numbers, a space, and punctuation marks.

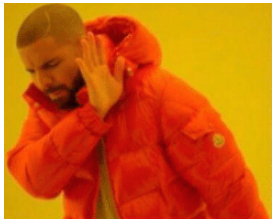
Why Digital Communication?

- **Economically**

Digital microprocessors are cheap, versatile, and power-efficient

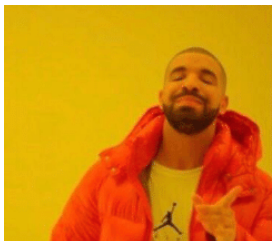
- **Signal Quality**

Digital communication has enhanced immunity to noise and interference



How Analog
Sigs Respond to
Noise/Distortion

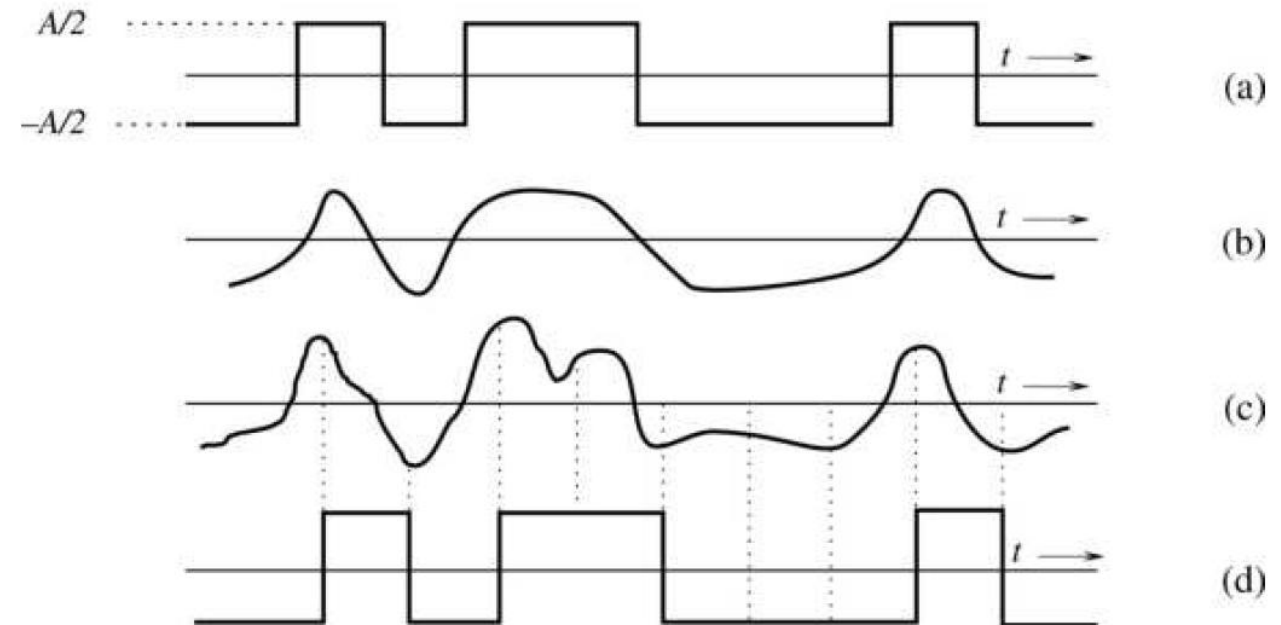
Distortion will appear at
the receiver end;
Less immunity



How Digital Sigs
Respond to
Noise/Distortion

Only between two values;
The fine details of the
shape is not an issue

- ECE 3710 provides you an introduction to these topics!



(a) Binary Signal Input to the Channel

(b) Signal Altered by Channel (Distortion)

(c) Signal Distortion Plus Noise

(d) Detected Signal at the Receiver



Thank you!

Questions?

