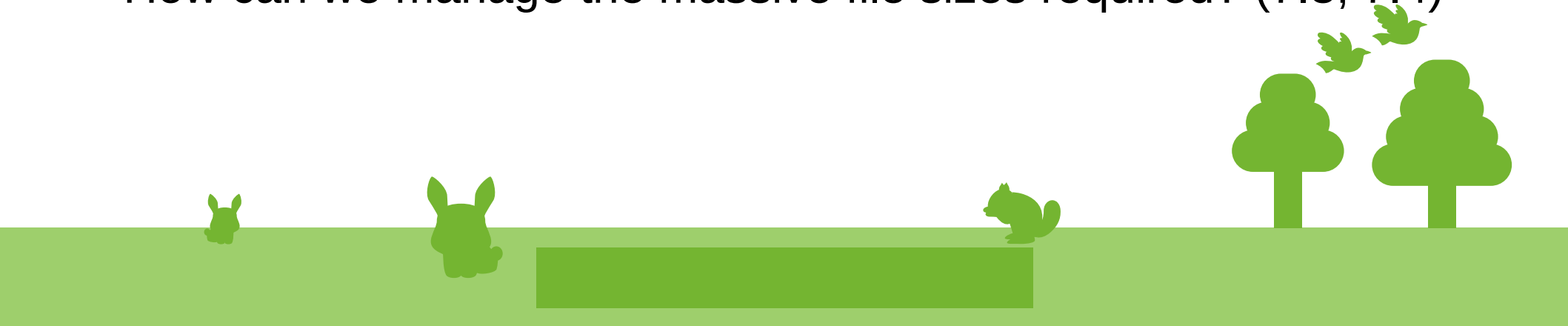
Multimedia Operating Systems

Main Outcome:
An overview of JPEG, MPEG, and MP3

Topics to Cover:
What makes multimedia files different from other file types? (7.1)
How are audio and video encoded for a computer? (7.2)
How can we manage the massive file sizes required? (7.3, 7.4)



Review: Functions of an Operating System

- Operating systems coordinate other processes in a computer system and allocate resources, like processing time, memory space, and hardware, to maximize efficiency of the system.
  - Manage multiple processors and hard drives
  - Keep track of which files are saved where

What makes Multimedia Different?

- Multimedia information has two main components which differ from other types of data (e.g., text or numerical data).
  - Extremely High Data Rates
    - An average uncompressed two-hour movie file contains 570 GB of data.
    - 570 GB / 120 minutes = 4.75 GB / min
  - Real-Time Playback
    - Network conditions often fluctuate; providers tend to measure:
      - Average Bandwidth
      - Peak Bandwidth
      - Maximum and minimum Delay
      - Probability of Bit Loss
    - Admission Control Algorithm

Encoding – Video Files

- Analog video was displayed on a screen by shooting it with electricity bullets, which is very cool but no longer relevant.
- Modern digital video is a data file containing a sequence of frames, which consist of a grid of rectangular picture elements (pixels).
  - Displaying a discrete image at a rate of twenty-five times a second creates the illusion of smooth motion.

Encoding – Audio Files

- Audio waves are converted to digital signals by a hardware component, the Analog Digital Converter (ADC)
  - ADC takes in an electrical voltage and outputs a binary number
- The continuous audio wave is made discrete by sampling at a given interval.
  - Error caused by sampling is called quantitative noise.
  - Quality is measured in Kilobytes Per Second

Video Compression – Part One

- Recall that video files are Huge, so compression is necessary to be able to manipulate those files.
  - Also remember compression is like shorthand for data files
- Compression and decompression are asymmetric
  - A file may be encoded only once but decoded thousands of times
    - A movie encoded when hosted on a server and decoded when watched
  - A file doesn't need to be exactly the same after being encoded, then decoded.
    - "Lossy" compression (or deep-fried memes if you prefer)

Video Compression – Part Two, JPEG Standard

- JPEG stands for Joint Photographic Experts Group
- The algorithm is complicated: a “lossy” summary would be to divide the file into blocks and take the average color of each block.
- Can achieve 20:1 compression
- Forms the basis for MPEG (Motion Picture Expert Group) standard for video files.

Video Compression, Final Part – MPEG

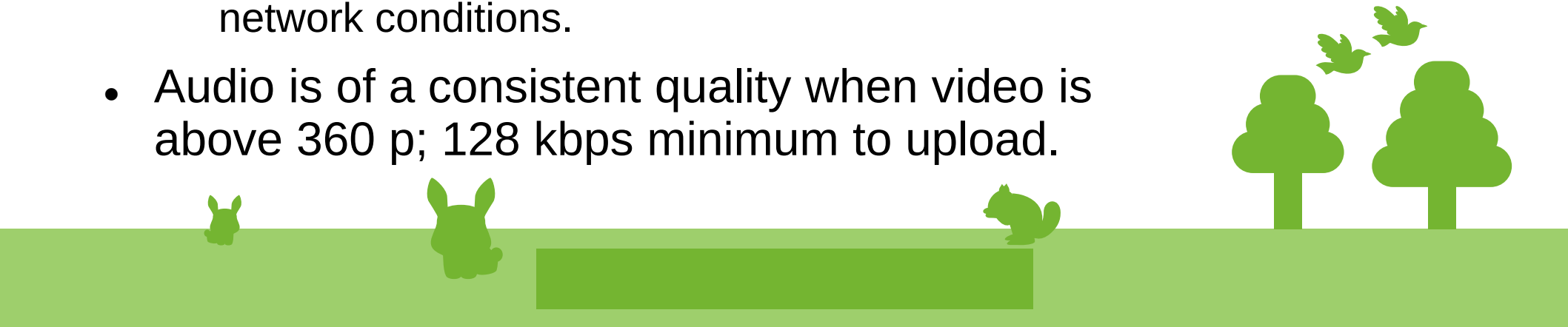
- A movie file is essentially a long list of still frames, i.e. JPEG's
- MPEG extends the compression by taking advantage of similarities between frames.
  - Frames are divided into 3 types:
    1) I-Frames: Intracoded. A JPEG stillshot used as a reference point.
    2) P-Frames: Predictive. Block-by-block differences with the previous frame.
    3) B-Frames: Bidirectional. Like a P-Frame, but compared with both the previous frame and the one upcoming.

Audio Compression – MP3

- MP3 stands for MPEG Audio Layer 3, most powerful and most commonly used audio compression protocol.
- Compression is achieved in two ways:
  1) Waveform Coding: the signal is mathematically broken down into its component frequencies, which are then encoded.
  2) Perceptual Coding: Since some sounds can mask others (e.g., jackhammers versus flutes) the data for any masked sounds can be deleted.

Real-World Usage: Youtube.com

- Massive amounts of hardware required to host and stream videos, as well as perform necessary operations like compression.
- Videos can be displayed at a range of qualities (i.e., levels of compression)
  - Lower quality helps maintain a constant data rate despite fluctuating network conditions.
- Audio is of a consistent quality when video is above 360 p; 128 kbps minimum to upload.



Thank you!