

# CS122A: Intermediate Embedded and Real Time Operating Systems

Jeffrey McDaniel

University of California, Riverside

# Dynamic Frequency Scaling

- ▶ Also known as **CPU throttling**

# Dynamic Frequency Scaling

- ▶ Also known as **CPU throttling**
- ▶ The frequency of a microprocessor can be adjusted to conserve power

# Dynamic Frequency Scaling

- ▶ Also known as **CPU throttling**
- ▶ The frequency of a microprocessor can be adjusted to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$

# Dynamic Frequency Scaling

- ▶ Also known as **CPU throttling**
- ▶ The frequency of a microprocessor can be adjusted to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched

# Dynamic Frequency Scaling

- ▶ Also known as **CPU throttling**
- ▶ The frequency of a microprocessor can be adjusted to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched
  - ▶ V is the voltage

# Dynamic Frequency Scaling

- ▶ Also known as **CPU throttling**
- ▶ The frequency of a microprocessor can be adjusted to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched
  - ▶ V is the voltage
  - ▶ A is the activity factor (average number of switching events)

# Dynamic Frequency Scaling

- ▶ Also known as **CPU throttling**
- ▶ The frequency of a microprocessor can be adjusted to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched
  - ▶ V is the voltage
  - ▶ A is the activity factor (average number of switching events)
  - ▶ and f is the frequency



# Dynamic Frequency Scaling

- ▶ Also known as **CPU throttling**
- ▶ The frequency of a microprocessor can be adjusted to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched
  - ▶ V is the voltage
  - ▶ A is the activity factor (average number of switching events)
  - ▶ and f is the frequency
- ▶ Reducing  $f$  reduces dynamic power

# Dynamic Frequency Scaling

- ▶ Also known as **CPU throttling**
- ▶ The frequency of a microprocessor can be adjusted to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched
  - ▶ V is the voltage
  - ▶ A is the activity factor (average number of switching events)
  - ▶ and f is the frequency
- ▶ Reducing  $f$  reduces dynamic power
- ▶ Dynamic power is still dominated by  $V^2$  component

[en.wikipedia.org/wiki/Dynamic\\_frequency\\_scaling](https://en.wikipedia.org/wiki/Dynamic_frequency_scaling)

# Dynamic Voltage Scaling

- ▶ **Overvolting** is Dynamic voltage scaling to increase voltage (overclocking)

# Dynamic Voltage Scaling

- ▶ **Overvolting** is Dynamic voltage scaling to increase voltage (overclocking)
- ▶ **Undervolting** is dynamic voltage scaling to decrease voltage to conserve power

# Dynamic Voltage Scaling

- ▶ **Overvolting** is Dynamic voltage scaling to increase voltage (overclocking)
- ▶ **Undervolting** is dynamic voltage scaling to decrease voltage to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$

# Dynamic Voltage Scaling

- ▶ **Overvolting** is Dynamic voltage scaling to increase voltage (overclocking)
- ▶ **Undervolting** is dynamic voltage scaling to decrease voltage to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched

# Dynamic Voltage Scaling

- ▶ **Overvolting** is Dynamic voltage scaling to increase voltage (overclocking)
- ▶ **Undervolting** is dynamic voltage scaling to decrease voltage to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched
  - ▶ V is the voltage

# Dynamic Voltage Scaling

- ▶ **Overvolting** is Dynamic voltage scaling to increase voltage (overclocking)
- ▶ **Undervolting** is dynamic voltage scaling to decrease voltage to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched
  - ▶ V is the voltage
  - ▶ A is the activity factor (average number of switching events)



# Dynamic Voltage Scaling

- ▶ **Overvolting** is Dynamic voltage scaling to increase voltage (overclocking)
- ▶ **Undervolting** is dynamic voltage scaling to decrease voltage to conserve power
- ▶ Dynamic Power =  $C * V^2 * A * f$ 
  - ▶ C is the capacitance being switched
  - ▶ V is the voltage
  - ▶ A is the activity factor (average number of switching events)
  - ▶ and f is the frequency

[en.wikipedia.org/wiki/Dynamic\\_voltage\\_scaling](https://en.wikipedia.org/wiki/Dynamic_voltage_scaling)

# Dynamic Voltage and Frequency Scaling

- ▶ Dynamic Power =  $C * V^2 * A * f$

# Dynamic Voltage and Frequency Scaling

- ▶ Dynamic Power =  $C * V^2 * A * f$
- ▶ Dynamic voltage scaling reduces  $V^2$

# Dynamic Voltage and Frequency Scaling

- ▶ Dynamic Power =  $C * V^2 * A * f$
- ▶ Dynamic voltage scaling reduces  $V^2$
- ▶ Dynamic frequency scaling reduces  $f$

# Dynamic Voltage and Frequency Scaling

- ▶ Dynamic Power =  $C * V^2 * A * f$
- ▶ Dynamic voltage scaling reduces  $V^2$
- ▶ Dynamic frequency scaling reduces  $f$
- ▶ When used together can reduce the dynamic power even further, conserving power