McGill

# ECSE 420
# Lab 1: OpenMP

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# Outline

- OpenMP
- More info on Lab 1
- Work on Lab 1

# OpenMP

- Another multithreading framework
- `#include <omp.h>`
- Compile with “-fopenmp”
- Like Pthreads, but lots of stuff is automated for you!

# OpenMP

- Thread creation and joining:
  `#pragma omp parallel`
- To get thread id, use
  `omp_get_thread_num()`
- To get number of threads, use
  `omp_get_num_threads()`
- To set number of threads, use
  `num_threads(<+ve integer>)`
- Put {} on next line to indicate create-join section

# OpenMP

- Beware variable scope!
- Variables declared **within a parallel block** are **private** to each thread
- Variables declared **outside of a parallel block** are **shared** between threads
- To create a private copy of a variable declared outside of a parallel block and give to each thread, use `private(<variable name>)`

# OpenMP

- Automatic work sharing:

```
#pragma omp parallel for
```

- Note: do not put anything between the `#pragma omp parallel for` and `for()` (e.g., don't put {})

# OpenMP

- Mutual exclusion:

```
#pragma omp atomic
#pragma omp critical
```

- `critical` can contain multiple statements using {}; `atomic` must be followed by a single statement (no {} allowed)
- But `atomic` is much more efficient than `critical`

# OpenMP

- **Reduction:** `#pragma omp parallel for reduction (<op>:<destination variable>)`
- Write sequential for-loop over associative ops
  → OpenMP transforms it into a reduction

# Lab 1

- For this lab, use the simple **lodepng** library
  - Load .png files into `unsigned char` arrays
  - Save processed images as .png files
- Images consist of 4-byte pixels
- Each pixel is "RGBA"
  - R = red, G = green, B = blue, A = alpha (opacity)
  - Each byte = "intensity" between [0,255]
  - Bytes in array come in order RGBARGBARGBA...
- For this lab, operate on R, G, and B separately, and leave A alone

# Lab 1

- Let's do an example using lodepng: changing an image from **color** to **grayscale**
- For each R byte, set corresponding G and B equal to R