Design Requirements

In this lab, you will use performance counters to measure the performance of various aspects of your code from Lab 2.

First, make sure your CPU type is set to NIOS II/f and has support for hardware multiply and also includes hardware floating-point. Next, add a performance counter to your system design.

Use performance counters to determine how many cycles are required on average to transform one pixel with the rotation transform using the following cache configurations for the NIOS II/f:

1. 4K instruction cache, no data cache
2. 4K instruction cache, 4K data cache
3. 4K instruction cache, 16K data cache

After this, replace all floating point multiplies and adds with fixed point multiplies and adds. Maintain an accuracy of at least $2^{-9}$ and use rounding when converting to integers. After this, repeat the same tests as above.

Use preprocessor directives such as `#define` and `#ifdef` to make it convenient to switch between fixed point and floating point. For example:

```c
#define FIXED_POINT
...
#endif
```

```c
sin_val = (alt_32)(sin(angle) * 512.0);
cos_val = (alt_32)(cos(angle) * 512.0);
```

`#ifdef FIXED_POINT`

```c
sin_val = sin(angle);
cos_val = cos(angle);
```

`#endif`

Project Submission

In addition, each group must submit a report that describes their performance results for each test case above.