PREPARATION

You will need a LaunchPad, a slide potentiometer, two switches, two LEDs, and the appropriate resistors to interface the switches and LEDs. If you have the Nokia 5110 you may use it. The Nokia 5110 LCD is optional.

STARTER PROJECT

Lab15_SpaceInvaders

PURPOSE

This lab has these major objectives: 1) learn modular design by putting all the components of the class into one system; 2) the development of a second ISR using one of the timers, creating three threads; 3) learn how to represent and maniputate images as two-dimensional arrays; 4) design, test, and debug a large C program; and 5) review I/O interfacing techniques used in this class. An addition component of this lab will be code review. After May 7, you will be able to view the YouTube videos. After May 14, you will be able to download and run code written by other students. This will allow you to observe the good and not so good practices of your fellow students. You can add compliments and constructive feedback to their YouTube video.

SYSTEM REQUIREMENTS

Refer back to Section 15.1, Requirements Document, for a general description of the game. In this section we will list detailed specifications needed to be able to share your game with others.

- It must run on a real LaunchPad, or run in the simulator with LaunchPadDLL version 1.0.0.6 (or higher)
- It must compile in Keil using the either the **Lab15_SpaceInvader** or **Lab15_VirtualSpaceInvaders** project simply by copy-pasting your code into the SpaceInvaders.c file, without changing any of the other files in the project, and without adding any additional files to the project. Your project may use 1) the simulator, 2) the real Nokia or 3) the virtual Nokia (UART+TExaSdisplay).
- The compilation must occur with the 32k-limit free version of Keil
- The slide pot must be attached to PE2/AIN1
- Two buttons must be attached to PE1 and PE0
- Two LEDs must be attached to PB5 and PB4
- The 4-bit DAC must be attached to PB3-0

- If you use the real Nokia5110, it is interfaced to PA7, PA6,PA5,PA3,PA2
- If you use the virtual Nokia5110, then TExaSdisplay version 1.08 (or higher) must be running

Help

Please write a little code, and then test it. Then write a little bit more code and test it again. If you write a lot of code, and then try to test it, you could get hopelessly lost.

Also remember the free version of Keil limits the memory image (RAM+ROM) to be less than 32k. So, you will have to keep your images and sounds small. You can see the percentage of the 32k limit when you start the debugger. For example, the starter project itself uses 28% of the available space.

```
*** Currently used: 9336 Bytes (28%)
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There is an option for those students who do not have a real Nokia. Start with the **Lab15_VirtualSpaceInvaders** project which is included as step 8 at http://edx-org-utaustinx.s3.amazonaws.com/UT601x/download.html (http://edx-org-utaustinx.s3.amazonaws.com/UT601x/download.html) For more details on the virtual display, see the section on debugging on the real board.

There is a **psychology** for developing games that are fun to play. Fun games are easy to learn but exciting to play. Successful games give the illusion of being difficult or dangerous, but at the same time the game is actually not as hard to play as it seems. If you want users to like your game, you need to let them "win" without letting them know you are letting the win. Successful games also invoke positive reinforcements in the player. One type of positive feedback is called **consistent reinforcement**, which are good things that always happen when one plays the game. A second type of positive feedback is called **inconsistent reinforcement**, meaning occasionally something wonderful happens.

Help