Grading Summary for ECE 2031 Lab Reports

Summary of Lab Reports

Lab reports for ECE 2031 are collections of images, tables, and code that were produced during the design, implementation, and test of digital hardware. The reports do *not* include paragraph-style descriptions of background, procedure, or conclusions, but each result is formatted and captioned as if it were to be included in a larger technical document. The purpose of the report is to show that you completed the lab steps, but also that you understand what was done, and its context within digital hardware engineering.

Each lab's report is worth 150 points towards the "prepared work" category of the course grade:

- 80 points for the presence and accuracy of the required information.
- 50 points for clearly and concisely presenting the information.
- 20 points for adhering to the document formatting requirements.

These categories reflect the fact that engineers and scientists strive for more than just accuracy; we also ensure that information is presented to our audience as clearly and effectively as possible.

Lab Report General Policies

Pre-lab check-offs should be completed by X:20 in the first hour of lab. If any pre-lab check-off is late (and unexcused), the lab report will be penalized according to the most-late one: 10 points if still prior to X:55 of the first hour of lab, and 20 points after that. Even if late, pre-lab check-offs must still be done, or the rest of the lab report cannot be graded.

On the day that lab reports are due, they must be submitted by X:20 in the first hour of your lab section for full credit. Late lab reports are accepted up until X:55 of the first hour for a 10% (15-point) penalty, and are not accepted after that.

Submitted reports must have a check-off sheet and a filled-out evaluation sheet (name, section, date, signature) in order to be accepted. Lab reports with incomplete check-offs **are** accepted for partial credit, but only results corresponding to acquired check-offs will be graded.

All figures, tables, and code should be computer generated and labeled, unless specified as "unformatted" in the submission specification – see the "What to Submit for Each Lab" document for details.

Lab Report Grading Categories

Technical Accuracy (80 points)

Each result in the lab report, including its caption, is worth a number of points for its technical information. The "What to submit for each lab" document includes the point values associated with each result.

Points for technical accuracy are based on how much of the result is present and correct. For example, a simulation that only covers half of the required test cases will only earn half of that result's possible value, and a caption with technical errors will be penalized according to the severity of the errors.

For labs where later results are built upon earlier results, if technical errors are propagated, point deductions will apply to the first result, not on each result where the error is present. For example, if a K-map is solved incorrectly, any resulting Boolean expression and gate-level schematic will also be incorrect, so points will only be deducted the first time the error occurs.

Check-offs with no required associated result are graded based solely on the presence of the check-off.

Information Effectiveness (50 points)

Technical communication has a strong emphasis on the clear presentation of information. For ECE 2031 lab reports, this category requires the following:

- **Clear and concise captions**. Captions should explain the contents and context of the figure; see later sections of this document for additional guidelines. Ambiguity, rambling, colloquial or flowery language, confusing sentence structure, poor word-choice, spelling and grammar errors, and irrelevant information all reduce the effectiveness of your caption and will result in penalties.
- **Clear and concise images**. This the visual extension of the previous point, and requires (among other things) clear and logical layout of schematics and diagrams, appropriate image sizes and aspect ratios, and removal of unnecessary image elements and areas. Some common errors are described later.

Because each lab report contains a different number of results, the points in this category are distributed evenly between each [formatted] result. Each ineffective aspect of a result reduces its points by 1/3 (33%).

For grading simplicity, the score for this category will be calculated by summing the number of ineffective elements (at most three per result) and calculating the overall result, rounded to the nearest integer.

For example: if a lab report consists of six results and has four effectiveness errors, it would earn

$$50 * \left[1 - \frac{4}{6 * 3}\right] = 39\ points$$

Document Formatting (20 points)

All technical documents have some amount of formatting specification. The formatting specification for ECE 2031 lab reports follows a subset of IEEE formatting guidelines. All formatting requirements are detailed later in this document.

Formatting errors count off 5 points each, up to the maximum 20 points of this grading category.

Tips for Writing Effective Captions

- The purpose of a caption is to explain to the reader what the figure is and why it is important.
- Each caption must be self-contained; i.e. the reader should be able to understand the figure and caption without any of the other result and without any external documents (including the lab manual). This does not mean that external results or documents cannot be mentioned, but that the caption must still be complete if that reference was removed.
- The caption for each table or figure in your document will be unique. There is more than one way to effectively describe a figure or table.
- Included here in quotes are example snippets, ***not* full captions**.

For All Results

1. Before writing a caption, consider the purpose of the result in the larger context of the lab and course.
    a. What is the theme of the lab?
    b. How do the lab steps that created this result fit in to that theme?
    c. How does this result, rather than anything else that could have been captured, show what was done in the lab procedure?
    d. How does this result differ from other, similar results in the report?
2. Describe the result in a way that highlights its purpose within the overall lab and report.

Circuit Schematics

1. If you built the circuit to perform some function or task, include it in the title
    a. “Y = A'+B'C”
    b. “Output ‘happy’ is active when either input ‘playing’ or ‘eating’ is active”
    c. "4-bit full adder"
2. If there is a particularly important feature of the schematic, include it in the title
    a. "Showing the path with worst-case propagation delay"
    b. “with clock c5 attached to device dff3”

What to AVOID

1. Naming every component or listing every detail of the schematic
    a. Unless it is relevant to the result, avoid anything like "with two AND gates and three NOT gates”
    b. State machine schematics should not include the Boolean expression(s) of next-state logic, unless there is something notable about those expressions.
2. Relying on other figures or documents for descriptions to make sense
    a. **NO!** “Schematic circuit for previous truth table”
    b. **NO!** “Lab 1 circuit schematic”
    c. **NO!** “Circuit with worst-case path from pre-lab step 3”

Oscilloscope Captures

1. Explain where the signals come from.
    a. "breadboard circuit using HCT chips"
    b. "unknown circuit in <filename> running on a DE2 board" [note: referring to an external file is acceptable as long as the caption would still make sense without it]
2. If relevant, describe what type of signal is shown
    a. "A square/sine/sawtooth wave"
    b. "Clock", "data", "input", "output", etc.
3. If measuring something, describe what is being measured
    a. "The rise time of "
    b. "The period of "
4. If a required parameter is not immediately apparent in the capture, include its value in your title
    a. "A duty cycle of 33%"
5. If you have multiple signals, differentiate between them by color/position
    a. "V1 (dark blue) and V2 (light blue)"
    b. "Input (top) and output (bottom)"

Tables

1. Describe the table contents. If it's a truth table, explain the logic
    a. "Truth Table of Y = A'+B'C"
    b. "Propagation Delays of Texas Instruments ICs"
    c. "Karnaugh Map Producing Y = A'+B'C"
2. Include any special characteristics
    a. "with Highest Propagation Delays Highlighted"
    b. "Annotated to Show Delays"

Simulation Waveforms and Logic Analyzer Captures

1. Describe what is being simulated or captured
    a. "Circuit implementing …"
    b. "Decoder for I/O devices"
2. Include important features of the simulation
    a. "for all possible input combinations"
    b. "receiving data values 0x34 and 0x22"
    c. "showing expected final value of 0xFFFF"
    d. "with decoded opcode values for the first three instructions of *example.asm*"

Lab Report Formatting Requirements

Document Formatting

- Contents of lab reports must be in order: check-off sheet, evaluation sheet, and results. Results must be in the order listed in the lab manual. If the results contain one or more appendices, the appendices always go at the end of the report.
- Lab reports must be stapled in the top-left corner. Landscape pages within the report must be stapled in their top-right corner, such that previous pages are turned away from the reader when the landscape page is viewed.

Figure Formatting

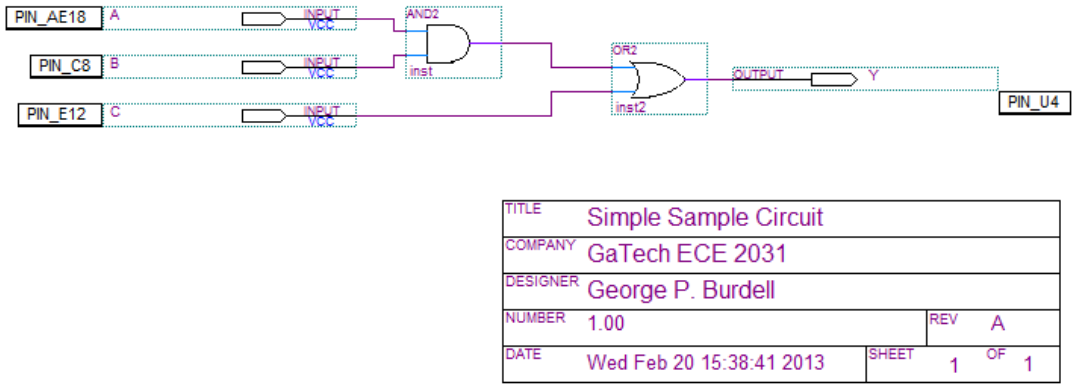


Figure 1. Schematic of circuit implementing $Y = (A \cdot B) + C$.

Bold

Period

Capitalize initial letter of first word, proper nouns, and acronyms

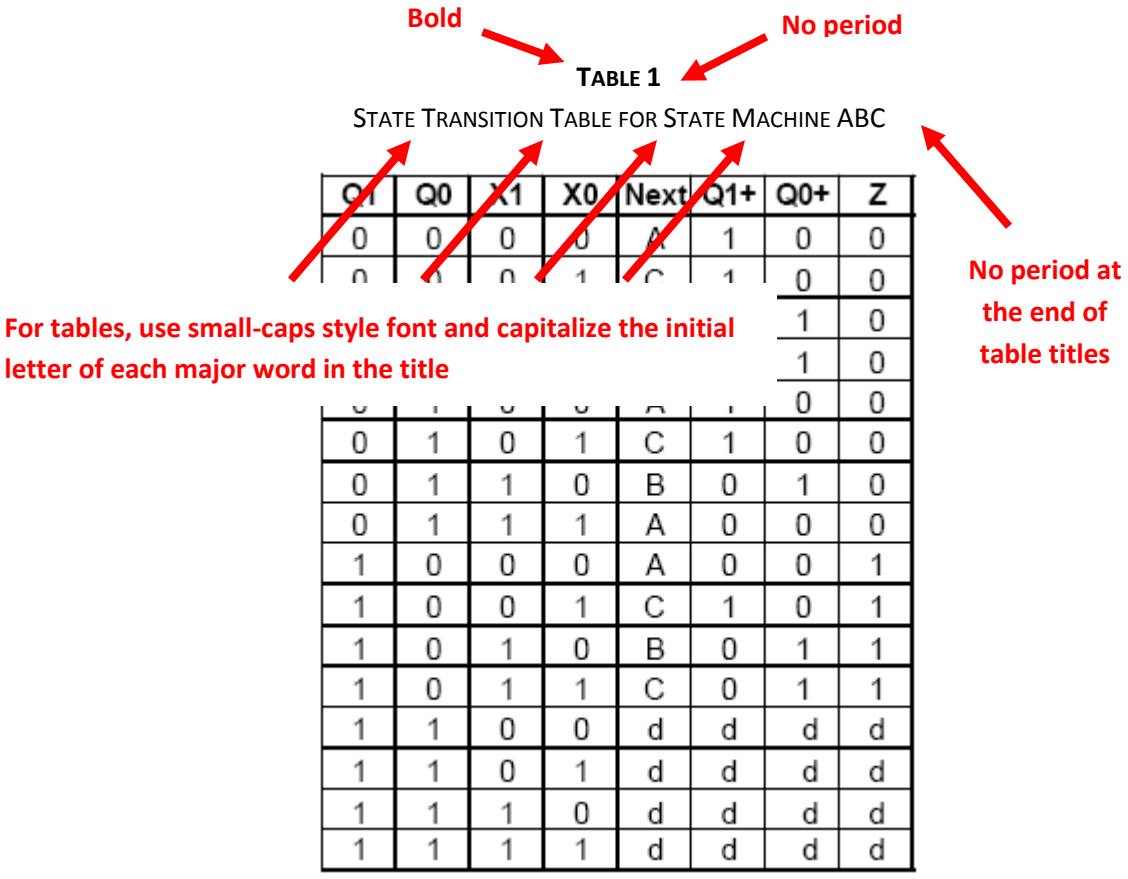
Figure and label are centered on page*

Period

*** Labels that fit on one line are centered. Labels that require two or more lines are left-aligned.**

- Code and other text that fits on one page should be formatted as a figure. Longer code should be included in an appendix.
- Code should always be in a fixed-width font and single-spaced.

Table Formatting



Q1	Q0	X1	X0	Next	Q1+	Q0+	Z
0	0	0	0	A	1	0	0
0	0	0	1	C	1	0	0
0	0	1	0	B	0	1	0
0	0	1	1	A	0	0	0
0	1	0	0	A	0	0	1
0	1	0	1	C	1	0	0
0	1	1	0	B	0	1	0
0	1	1	1	A	0	0	0
1	0	0	0	A	0	0	1
1	0	0	1	C	1	0	1
1	0	1	0	B	0	1	1
1	0	1	1	C	0	1	1
1	1	0	0	d	d	d	d
1	1	0	1	d	d	d	d
1	1	1	0	d	d	d	d
1	1	1	1	d	d	d	d

*** Table captions are always centered. If more than one line is needed, keep each line approximately the same length by manually inserting line breaks.**

Appendix Formatting

- Appendices always go at the end of a document.
- Appendices have a cover page with "Appendix A: [Appendix description]" centered vertically and horizontally on the page, where 'A' increments to 'B', 'C', etc. for subsequent appendices. See the example appendix later in this document.

Common Lab Report Errors

Common Effectiveness Errors

Vague or incomplete title or caption. Caption should describe the content and purpose the result, and contain enough information to be understood by itself. See caption tips earlier in this document for examples.
Spelling and grammar errors or ineffective wording. Proofread your document for mechanical errors as well as word-choice and sentence structure.
Failure to crop out unnecessary or useless areas from a screen capture or figure, such as toolbars, scroll bars, and empty space. Include only relevant information.
Stretched or skewed images. Preserve the original aspect ratio of technical images.
Graphics or in-image labels too small. Ensure that all necessary information in a figure is legible. This could result in technical errors if required information is no longer discernible.

Common Formatting Errors

Improper capitalization in title/caption.
Missing or incorrect use of punctuation in title/caption.
Missing or incorrect use of bold.
Code not in fixed-width font, or with extra line spaces.
Document or page(s) stapled in incorrect location.

Common Technical Errors

Describing figures in technically-incorrect ways, such as referring to assembly code as VHDL.
Missing title box on schematics.
Incomplete or ineffective comments in code, including missing header lines.

Additional Examples of Lab Results

Example with many errors

The following figure is the same circuit as in Figure 1, but with many errors.

fig 4 - step 5 state machine Resoult

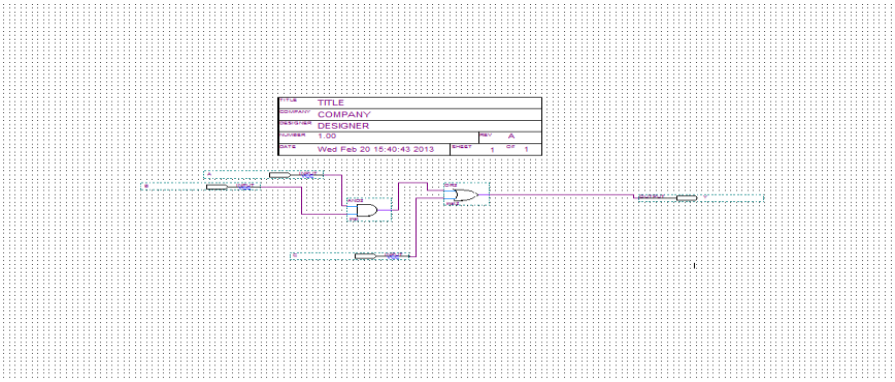


Figure formatting errors:

1. Stretched horizontally
2. Not centered on page

Figure effectiveness errors:

1. Improper cropping
2. Grid in background (dots)
3. Too small to read
4. Title block in wrong place
5. Excessively messy layout

Figure technical errors:

1. Title block not filled out
2. No pin numbers

Caption formatting errors:

1. In wrong place – above image and not centered
2. ‘Figure’ not bold, capitalized, or spelled out
3. Figure number out of order (should be 2 in this document)
4. No period after ‘4’ (hyphen used instead)
5. ‘Step’ not capitalized and 'Result' unnecessarily capitalized.
6. Spelling error
7. No period at end

Caption effectiveness errors:

1. Does not describe result content or purpose
2. Is not self-contained (refers to lab manual)

Caption technical errors:

1. Calls the combinational circuit a state machine.

Landscape pages within a portrait document are stapled here; i.e. this page gets rotated clockwise when read. Fully-landscape documents are stapled in the top-left.

Example of proper landscape page

You can orient your figures using portrait or landscape. Use landscape if the image is too large to fit in portrait and remain legible. When including a landscaped figure with other results, label the figure so that the title caption is on the right-hand side of the page when the page is vertical. This configuration is standard and allows the reader to turn the previous pages away from them instead of towards them.

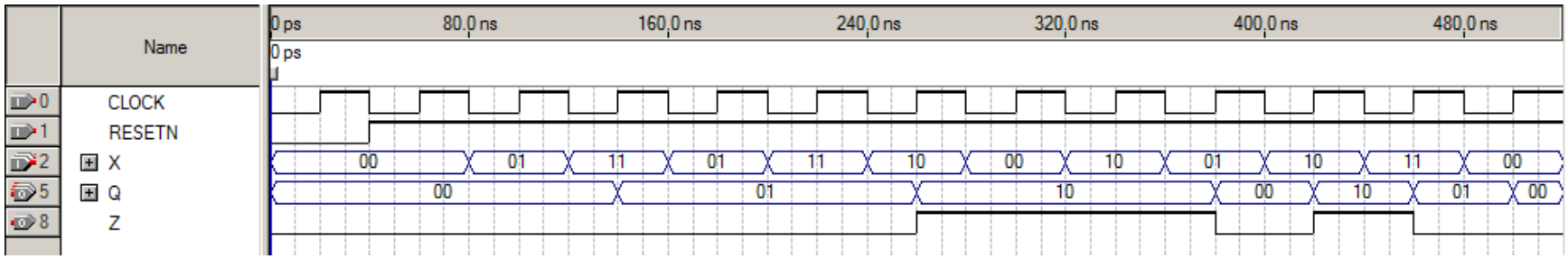


Figure 3. Functional simulation waveform of state machine with three states, 2-bit input X, and 1-bit output Z. The input vector provides 100% coverage of state transitions to prove correct behavior of the state machine, including assertion of Z in state '10'.

Example of code less than one page in length

Figure 4 is an example of properly formatted code that spans **less than a page**. Always place header comments in the first lines of every piece of code submitted, as shown below. Be sure to use a `fixed-width font` such as `Courier New` for code, and remove extra space between lines (Microsoft Word defaults to extra line space for newlines)

```
-- ORGATE.VHD (VHDL)
-- This code produces a negative-logic OR circuit
-- George P. Burdell
-- ECE2031 L01
-- 01/31/2009

LIBRARY IEEE;
USE IEEE.STD_LOGIC_1164.all;

ENTITY orgate IS
PORT(
      PB1, PB2 : IN STD_LOGIC;
      LED : OUT STD_LOGIC);
END orgate;

ARCHITECTURE a OF orgate IS
BEGIN
      LED <= NOT(NOT PB1 OR NOT PB2);
END a;
```

Code always contains header lines

Code that is less than one page is formatted as a figure

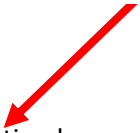


Figure 4. VHDL code used to turn off an LED when either of two active-low pushbuttons are pressed.

Example of code that spans more than one page

Appendix A: Example Long Code

When code is longer than one page in length, it should be NOT be labeled as a figure (i.e, don't put "Figure X: VHDL code" at the bottom of each page). Instead, treat each set of code as a separate appendix by creating a cover page (like this one) with a title that describes the code (or the appendix in general). Then include all of the pages of code after the cover sheet. If you have multiple sets of code, you would have several Appendices (A, B, C, etc.).

The title on the cover page of each Appendix should be centered as shown above.

Remember to use fixed-width font for code.

Code should ALWAYS be commented so that the reader understands how the code works.

Appendices ALWAYS go at the end of the document, regardless of result order.

```
--ORGATE.VHD
--Basic PS/2 keyboard interface with clock filtering
--George P. Burdell
--ECE 2031 L01
--01/31/2009

LIBRARY IEEE;
USE IEEE.STD_LOGIC_1164.all;
USE IEEE.STD_LOGIC_ARITH.all;
USE IEEE.STD_LOGIC_UNSIGNED.all;

ENTITY keyboard IS
   PORT(
      keyboard_clk, keyboard_data,
         clock_25Mhz, reset, read : IN STD_LOGIC;
      scan_code : OUT STD_LOGIC_VECTOR(7 DOWNTO 0);
      scan_ready : OUT STD_LOGIC);
END keyboard;

ARCHITECTURE a OF keyboard IS
   SIGNAL INCNT : std_logic_vector(3 downto 0);
   SIGNAL SHIFTIN : std_logic_vector(8 downto 0);
   SIGNAL READ_CHAR : std_logic;
   SIGNAL INFLAG, ready_set : std_logic;
   SIGNAL keyboard_clk_filtered : std_logic;
   SIGNAL filter : std_logic_vector(7 downto 0);
BEGIN

PROCESS (read, ready_set)
BEGIN
   IF read = '1' THEN scan_ready <= '0';
   ELSIF ready_set'EVENT and ready_set = '1' THEN
   scan_ready <= '1';
   END IF;
END PROCESS;


--This process filters the raw clock signal coming from the
--keyboard using a shift register and two AND gates
Clock_filter: PROCESS
BEGIN
   WAIT UNTIL clock_25Mhz'EVENT AND clock_25Mhz= '1';
   filter (6 DOWNTO 0) <= filter(7 DOWNTO 1) ;
   filter(7) <= keyboard_clk;
   IF filter = "11111111" THEN keyboard_clk_filtered <= '1';
   ELSIF filter= "00000000" THEN keyboard_clk_filtered <= '0';
   END IF;
END PROCESS Clock_filter;
```

```
--This process reads in serial data coming from the terminal
PROCESS
BEGIN
WAIT UNTIL (KEYBOARD_CLK_filtered'EVENT AND KEYBOARD_CLK_filtered='1');
IF RESET='1' THEN
      INCNT <= "0000";
      READ_CHAR <= '0';
ELSE
   IF KEYBOARD_DATA='0' AND READ_CHAR='0' THEN
      READ_CHAR<= '1';
      ready_set<= '0';
   ELSE

      -- Shift in next 8 data bits to assemble a scan code
      IF READ_CHAR = '1' THEN
         IF INCNT < "1001" THEN
            INCNT <= INCNT + 1;
            SHIFTIN(7 DOWNTO 0) <= SHIFTIN(8 DOWNTO 1);
            SHIFTIN(8) <= KEYBOARD_DATA;
            ready_set <= '0';
            -- End of scan code character, so set flags and exit loop
         ELSE
            scan_code <= SHIFTIN(7 DOWNTO 0);
            READ_CHAR <='0';
            ready_set <= '1';
            INCNT <= "0000";
         END IF;
      END IF;
   END IF;
END IF;
END PROCESS;
END a;
```