STATEMENT OF WORK

1

Assignment 1 – CSE 6329

Produce and Utilize a Personal Work Breakdown Structure (PWBS)

**What is the purpose of this assignment?**

This assignment will introduce you to some basic steps of project measurement:

* **planning** a project (identifying the work tasks that will be measured),
* **organizing** the project (putting the tasks in a reasonable order),
* **estimating** the cost of the project (in hours of work),
* **tracking progress** (recording actual hours worked and tasks completed),
* **reporting progress** (using earned value and burn charts),
* **learning from your measurements** (so you can estimate better in the future),and
* **using a spreadsheet** for the above activities.

For this assignment, your “project” is **taking this course** and your tool for planning, organizing, estimating, tracking and reporting is a “personal work breakdown structure” (PWBS).

**What is a PWBS?**

The PWBS or **Personal Work Breakdown Structure** is a Microsoft Excel® workbook that shows your plan for taking the course (tasks to be performed and estimated hours required for each task), the time actually spent each week on each task, and the work completed (earned) each week. A template is provided as a starting point, but you must modify that template as you develop your estimates and plans. You will deliver the PWBS at least **three** times:

1. **DRAFT PWBS.** For class session #2 you will deliver an initial DRAFT of the PWBS, showing your plan for taking the course and the work actually performed during the first week of the course. See **deliverables** (below) for the specific file naming convention. The instructor and grader(s) will evaluate your draft and give you comments and suggestions. The grade on this version will be advisory and will not count toward your final course grade.
2. **INTERIM PWBS**. For class session #4, you will deliver an INTERIM version of the PWBS, showing the work performed during the first three weeks of the course as well as any revisions to your plan. **This interim version will receive a grade that counts as part of your final course grade.**  Note: revisions to your plan typically result from two things:
   1. comments received from the instructor or grader about your DRAFT PWBS, and
   2. changes made because of teaming.

If your interim submission is not sufficient, we may suggest that you make corrections and check with the grader or instructor to make sure you are doing it correctly.

1. **FINAL PWBS**. At the end of the semester, after the last class, you will turn in the FINAL version of the PWBS, showing all work performed during the semester. **This final version will receive a grade that counts toward your final course grade.**

**So what exactly must I do for Assignment 1A (DRAFT PWBS)?**

For assignment 1A, you will **make a plan** for taking this course, **document that plan** in your PWBS, **estimate the effort** required to carry out each task included in your plan, and **track progress** (record the actual time spent and work completed) for the first week of the course.

* To **make your plan**, you must examine all course assignments and **figure out what tasks you will perform** as you complete those assignments. This is a lot of work, but that’s what planning is all about. If you do this well, the rest of the course will be easier.
* To **document your plan** you will record all tasks (and your estimate of how long each task will take) in your PWBS. You will record all tasks by modifying the PWBS template to put all of your tasks into the spreadsheet (one row for each task). In other words, you will provide the details of your plan.
* You will then **estimate** how much effort it takes to do each of the tasks and record that in the PWBS.
* To **track progress**, you will keep track of **how much time you actually spend on each task**, using the PWBS to record the time spent each week.
  + For each task that you work on, you will record three things **each week**:
    - **actual** **hours worked** on each task, regardless of whether or not you completed the tasks,
    - **estimated hours of work remaining** for each task, and
    - **hours earned** for tasks you completed this week.

(these are three separate things).

* + For the DRAFT version of the PWBS, you will only record this information for the first week of the course.
  + For the INTERIM version of the PWBS, you will record this information for the first three weeks of the course.

If you are teaming with another student, *each of you should have your own PWBS*, but you may want to collaborate to identify the tasks and decide how many hours you estimate that each of you will spend on each task.

**What happens after I turn in the DRAFT PWBS?**

First of all, you should take time to study the PWBS spreadsheet and understand each formula and how each graph is created. There may be questions on the midterm or final exam about the spreadsheet.

Secondly, you should pay close attention to any comments made by the grader or instructor when they evaluate your DRAFT PWBS. You may need to change your plan as a result of this. You may also decide to change your plan somewhat because you have selected a team mate and the two of you have decided how to allocate the work between you. For example, instead of both of you performing a task, you may decide to split it into two parts with one of you doing each part. Or you may decide to have one of you perform the task and the other review what was done. Make sure that both of you know how to perform each task. There may be a question on an exam about this.

**What do I submit for Assignment 1B (INTERIM PWBS)?**

Each week during the semester, as you work on the various assignments, you will record your **actual** **hours worked**, **estimated hours remaining** and **hours earned** in the PWBS. At the end of week 3 (the day of lecture 4) you will turn in the INTERIM PWBS. For this INTERIM version, you will have recorded the time spent during the first three weeks of the course.

**And What about Assignment 1C (FINAL PWBS)?**

For the FINAL version you will record all time spent on the course. You will turn this in at the end of the semester, after the last class session (but before the final exam). On this final PWBS, your various charts should show your progress through the whole semester.

If you do all of this properly, it will help you understand your progress and help you allocate your time so you can complete the course assignments on time.

**Work to be Performed:**

**Week 1:**

**At the beginning of the week:**

1. **Construct the DRAFT PWBS.** Using the PWBS template (see below), prepare a ***Personal Work Breakdown Structure*** that describes the detailed work tasks *you* will do for this course (for all assignments). [This is a lot of work.]
2. **Estimate the time required for each task** and record that information in the ***Estimated Hours of Effort*** column in the PWBS. Put the same estimate in the ***Estimated Hours Remaining*** column (see Appendix A).

**At the end of the week:**

1. **Record *Actual Hours Worked*** for each task you work on during the first week of the course.
2. **Update the *Estimated Hours Remaining*** for each task you work on[for example, if you complete a task, the estimated hours remaining will be changed to 0.]
3. **Compute** the ***Hours Earned*** [this is recorded near the bottom of the WBS]
4. **Submit the DRAFT PWBS for review (at the end of week 1 - midnight on the day of the second class session).** See **Deliverables** (below) for the required file name.

**Weeks 2-3:**

1. **Continue to record *Actual Hours Worked***, ***Estimated Hours Remaining*** and ***Hours Earned*.** Continue recording all of these each week. You should also examine the various graphs (charts) to track your progress. Finally, you should study the PWBS spreadsheet so you understand each formula and how each graph is produced.
2. **Submit the INTERIM PWBS (at the end of week 3 – midnight on the day of the fourth class session).** See **Deliverables** (below) for the required file name.

**Weeks 4-n:** (until the end of the semester)

1. **Continue to record *Actual Hours Worked***, ***Estimated Hours Remaining*** and ***Hours Earned*.** Continue recording all of these each week as you go through the semester. You should also examine the various graphs (charts) to track your progress.
2. **Submit the FINAL PWBS** (at the end of the semester). See **Deliverables** (below) for the required file name.

**Note:**the template for your PWBS has the following file name: *“***A1 CSE 6329 2019fa PWBS template.xlsx”.** This can be found on the course Canvas site under **Assignment 1.**

See **Appendix A** and the template for details on the structure of the PWBS workbook and what you are to do with it. Also, be sure to read the **instructions** tab in the template.

Note: as you do the various assignments for the course, you will record the hours of work performed each week in the PWBS. You must also update the estimated hours remaining (which will usually change a little each week as you revise your estimates of how long it will take to do things). You will also record hours earned (hours are earned only when you complete a task). Your progress will be displayed in the **Burn Down Chart, Burn Up Chart** and **Earned Value Charts**. You should plan to use these charts to track your progress. If the charts do not make sense, see the instructor or a grader to straighten things out. If you don’t have correct graphs or are not recording your hours correctly, you will lose credit on the INTERIM and FINAL version of the PWBS. Moreover, the longer you wait to fix any problems, the harder it will be to accurately correct them. Furthermore, you will lose the benefit of having these graphs to help you manage your time.

At the end of the semester, you will record the hours spent and earned for the final week of the course and turn in the final PWBS along with your other assignments that are due at that time.

**Deliverables**:

**Week 1: Draft PWBS** (result of Appendix A steps a-f).

* Change the template file name to replace the word “**Template**” with “**last first**” where “**last**” is your last or surname and “**first**” is your first or given name. Also add the word “**DRAFT**” to the file name to distinguish it from the interim or final version. In other words, what you submit will have this file name:
  + - * “**A1 CSE 6329 2019fa DRAFT PWBS last first.xlsx**”
* The grader or instructor will send it back with comments and suggestions

**Week 3: Interim PWBS** (result of Appendix A steps a-f for first three weeks).

* Submit your INTERIM PWBS. This version will count 5% of your course grade. The file name will be:
  + - * “**A1 CSE 6329 2019fa INTERIM PWBS last first.xlsx**”

**Week 14: Final PWBS** (result of Appendix A steps a-f for entire course – but steps a-b will not change).

* Submit your FINAL PWBS. This version will count 5% of your course grade. The file name will be:
  + “**A1 CSE 6329 2019fa FINAL PWBS last first.xlsx**”

**Note**: All versions of the PWBS must be **Excel®** documents, created by modifying the *“***A1 CSE 6329 2019fa PWBS template.xlsx**” file in accordance with the process described in Appendix A of this SOW.

**Formatting rules for deliverables:**

Your name must appear in three places:

* 1. In the file name, as described above,
  2. On the cover sheet (first worksheet in the template), and
  3. At the top of ***the third*** worksheet (the one labeled WBS). Put your name where it says  .

(I have a collection of WBSs, worksheets and graphs from previous students who forgot to put their names on them. I don’t know which is which!)

#### APPENDIX A

**PREPARATION of PERSONAL WORK BREAKDOWN STRUCTURE**

for

Recording and Tracking Student Effort

in

Completing the CSE 6329 Course Assignments

(Use these instructions to help you better understand how to use the template)

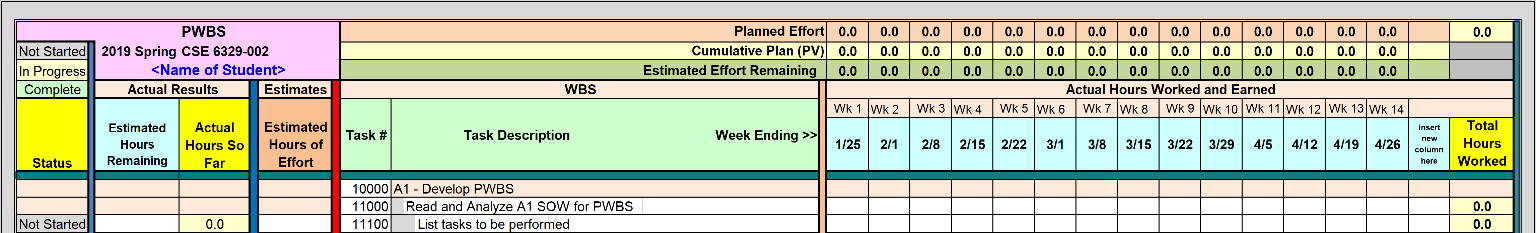
Note: it may be helpful to open and examine the PWBS template while looking at the following information. The actual template may be slightly different from the examples shown here.

#### Overview

The Personal Work Breakdown Structure is a tool used to help you estimate and track your effort in doing the assignments for this course. It is implemented as a Microsoft Excel® workbook containing five worksheets (tabs at bottom):

1. **Cover Sheet** [where you provide your name and other information. May be used by instructor/grader to give you comments.]
2. **Instructions** for Recording Weekly Hours Worked and Earned
3. **WBS** - Work Breakdown Structure worksheet (Figure 1).
4. **Burn Charts** worksheet
5. **Earned Value Graphs** worksheet

The third tab is the WBS (see Figure 1). This is where you will spend most of your time. It shows all work you are supposed to do for the course and your progress in completing that work. It includes your initial estimate and your final actual values for the hours of work you personally spend (your personal effort) to complete the course assignments. When complete, it should take approximately 3-5 pages if printed.



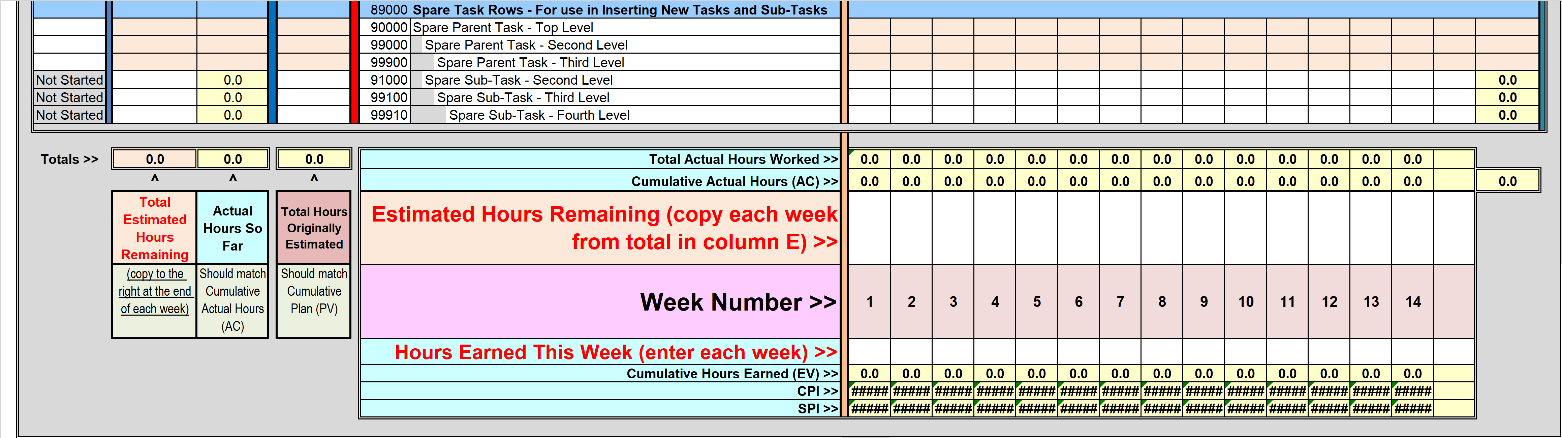
**…**

Figure 1 - WBS Template (showing top part and bottom part)

The columns under the heading “**WBS**” contain your work breakdown structure and, to the left of that, there is information on your estimates and your overall progress. The section on the right (“**Actual Hours Worked and Earned**”) is where you record your weekly progress (actual hours worked) so you can track your effort throughout the semester and continuously evaluate progress.

The burn charts worksheet and the earned value charts worksheet show, graphically, how your are progressing. You should look at these each week to see how you are doing relative to your plan. If you do things correctly, these charts will be generated automatically by the template.

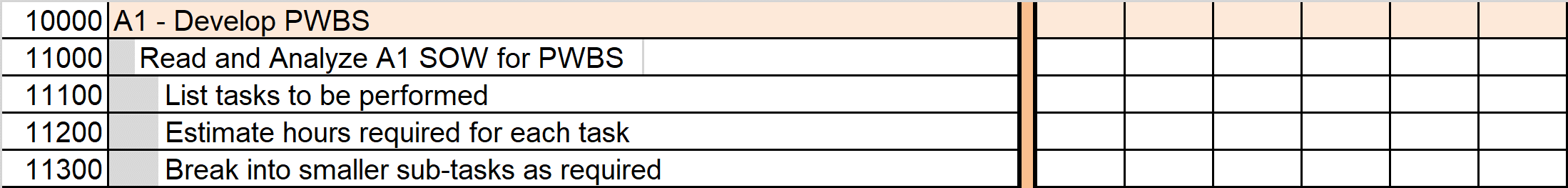
The template for this workbook is provided with the course materials for assignment 1. However you must modify that template to document your specific plan for the course. This modified template will be YOUR PWBS. The information below explains how each of the parts is organized. This will help you understand what to modify and how to do it.

***Note on spreadsheet template*:**

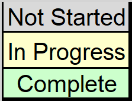
The template is color coded as follows:

**white –** *cells you may change*. In most cases, cells with a white background are cells where you may be expected to fill in numbers or other information. In some cases, the template already contains sample values, which you may change.

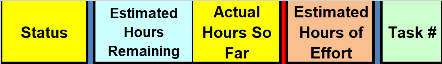
For example, here is an excerpt from the WBS portion of the worksheet:



In the above, the part on the left is where you list your tasks (your WBS) and the part on the right is where you enter the actual hours worked on each task each week. Note that in some cases, when you enter a value in a white cell it will change color. The color change is a convenient way of noting which cells you have entered data into. You may still change the data in such cells if you need to.

**yellow –** *cells containing formulas*. Cells in yellow (and occasionally other colors) contain formulas, most of which you will not normally change.

**Examples ->**

**grey, blue, green, and other colors –** *labels and titles*. These are generally used for titles, labels and spacing. These are not normally changed.

**Examples ->**

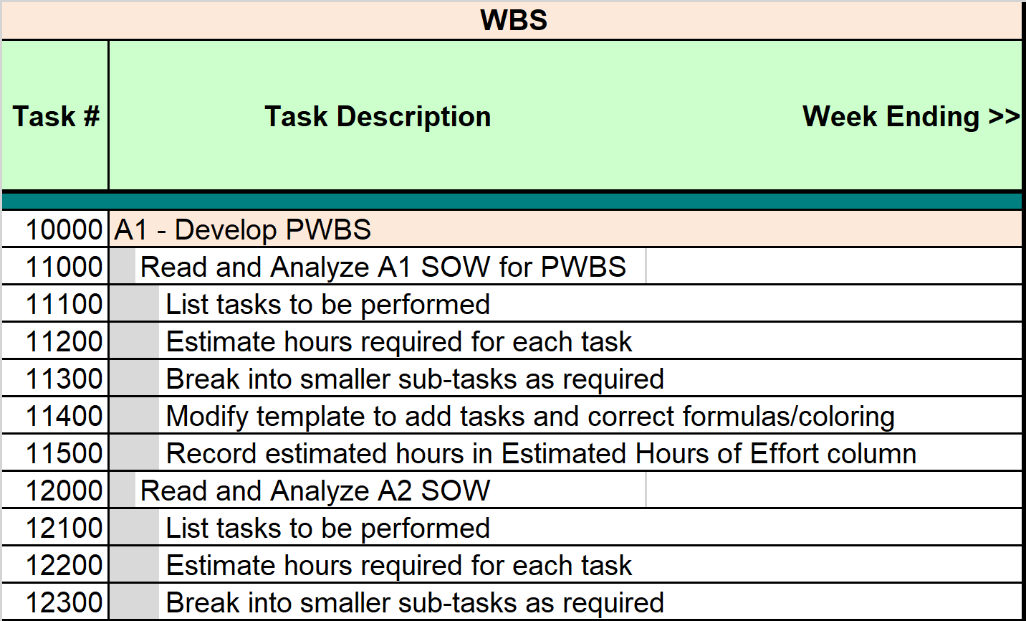
Sometimes when you enter a value in a white cell, it will change color. It is OK to change the numbers in such cells.

**Also, there are a few cases where these cells contain formulas that you may need to adjust. That should only happen if you extend the length of the course, which you should only do with the instructor’s permission.**

#### Constructing the WBS Sheet

The initial (DRAFT) submission of the PWBS (assignment 1a) is focused mainly on making and documenting your plan. The plan is documented in the WBS tab of the PWBS. However, in addition, you will also record the time actually spent for the first week (in the first “**Actual Hours Worked and Earned**” column). Completing the PWBS involves six steps (a-f). **Note: it is important for you to complete all steps during the first week of the course – otherwise these instructions are not quite right with regard to recording hours spent and you will need to adjust accordingly. Steps a-b are completed in the DRAFT version aned usually not changed after that. Steps c-f are completed each week.**

**Step a – Create your plan for the course -- WBS: Work to be Performed.**

In Step a, you create a list of the work tasks to be performed in doing all of the assignments for this course. This is divided into sections, corresponding to the individual assignments. (Developing the PWBS is part of assignment 1 or A1). Within each section, there is a list of work tasks needed to do the work for that assignment. Taken together, the sections describe all work you expect to do this semester in this course (except attending class). Note that the template (see figure above) shows a possible list of tasks and sub-tasks for assignment 1 – this is to help you get started. The template provides very little information for the remaining assignments – **you are expected to add many more rows to the PWBS spreadsheet, describing the tasks you will perform for the later assignments** – a row for each work task – so that, by the time you have completed your plan, you will have a dozen or more work tasks for each assignment.

**How do you determine the work tasks?** You do it the way any software team would do so – you read the available information (in this case, the SOW for each assignment and perhaps some of the related materials), determine the work to be done for each assignment, figure out what work tasks you must perform to complete that work, and make a list of these tasks. See more below.

**Note 1:** each person will devise his or her own unique set of work tasks, based on how they plan to go about performing the work. If you are teamed with another student, you may collaborate with them to determine how you will divide up the work. But each of you will have your own set of work tasks and, even if many tasks are the same as those of your team-mate, your estimated hours should be different for some of the tasks because each of you will do different things for most of the tasks.

**Note 2:** you should not simply divide the work and assign half of it to each student. Each student in a team is expected to know how to perform all tasks, and this may be tested on an exam. For very easy tasks, you may decide to assign the task to only one student. However, for more difficult tasks, each student should participate and thus each student should have a task row in their PWBS. In some cases, one student will perform the task and the other will review it to understand what was done. In other cases, each student will perform part of the task or they will do it together. Thus, if you are on a team, your list of tasks may be similar to your teammate’s list but will not be identical.

**Task Numbers**

Each task has a unique task number (see the column labeled “**Task #**”). This is a five-digit integer. The purpose of the task number is twofold: 1) to uniquely identify each task and 2) to keep the tasks in the right order. In other words, if you were to select all the task rows and sort them on the **Task #** column, they would come out in the correct order.

The first (leftmost) digit in the task number is the assignment number and the remaining digits indicate which task (or subtask) it is – see Figure 1 or the template for examples. Task 10000 is the top level or parent task for assignment 1, task 11000 is the first sub-task for assignment 1 and so forth. You may use any numbering system that you find convenient. For example, if you break task 11000 into smaller, sub-tasks, you might number them 11100, 11200, and so forth. Just be sure that the first digit is the assignment number. **See Appendix B for some alternative task numbering systems, which may be needed for some situations.**

You may include the time spent studying for exams in the WBS, in which case you may wish to come up with additional subtasks and subtask numbers for this.

Note that, in the template, subtasks are described one column to the right of their parent tasks and the cells to the left are greyed out. This makes it easier to see the hierarchy of tasks. When you insert new tasks into the WBS, you should make sure they are inserted at the correct position for their place in the hierarchy. To simplify this process, there are “spare” task rows for each possible task row you might wish to insert (“spares” are found at the bottom of the template – see bottom half of Figure 1). I strongly recommend using these “spare” task rows so as to get the formulas and formats correct.

For step “**a**” you will fill in the “tasks” (work to be performed), adding rows as you add new work tasks. If both members of a team will work on a task, you will often have similar lists of tasks for each student, but they should not be identical.

The template has a suggested list of tasks for a student working on assignment 1. The example in the template is only a suggestion for assignment 1 – you may change it as you see fit. Note especially that **the template is not complete for the later assignments**. It does not have enough work tasks or enough detail for assignments 2, 3, and 4. You may decide to modify or add tasks for assignment 1 or the exams as well. The template was provided to give you an idea of what is expected. You should examine all course assignments and determine all the work you will have to do. You must then plan that work (what tasks you will perform and when you will do them). That information will be used to construct a WBS that fits your specific plan. When done properly, a typical WBS is about 3-5 pages long.

A suggested process for constructing the task list for a specific assignment is as follows. I suggest doing this on paper until you have it the way you want it and then entering the actual task rows and estimates into the spreadsheet:

1. Look at the SOW for each assignment and find the list of high level tasks (**work to be performed**). Assign a PWBS sub-task for each of these tasks – these are the tasks you must perform for that assignment. For example, if it is assignment 2, the top-level task is 20000 and the sub-tasks would be 21000, 22000, 23000, etc.
2. Feel free to add more tasks if, after reading all materials for the assignment, you conclude that you will need to do things not mentioned as tasks in the SOW. If you are working with a teammate, you should work together on this (or you might work separately and then meet to compare and refine your lists of tasks).
3. When you estimate the hours required for each sub-task (step b, below), note which of them have greater than 2 hours. For each of those you should consider breaking it into sub-sub-tasks. For example, if task 22000 is estimated to take 6 hours, you might break it into sub-sub-tasks 22100 (2 hours), 22200 (2.5 hours), 22300 (1.5 hours), and so forth. It is permitted to have some tasks that are longer than 2 hours, but most should not be this large. (If all of your tasks are exactly 2 hours, we will interpret this to mean you did not make a serious attempt to estimate the time for each task.)
4. Repeat this process on the lower-level tasks (breaking large tasks into smaller ones) until most of your lowest-level tasks have time estimates of 2 hours or less.
5. Occasionally you will break a task into smaller tasks because it makes sense to do so, even though it is already small enough. For example, if a 2 hour task will be done in three steps, you might break it down into 3 sub-tasks, corresponding to the three steps. These might be estimated to take 1 hour, 0.6 hours and 0.4 hours, respectively.
6. Be careful not to break tasks into too many small sub-tasks. If all of your bottom level sub-tasks are 0.1 hours in length, you probably have too many small sub-tasks.

* **When you are done with this, your WBS will form an outline of the work to be done for the course.**

**Special Note for Teaming**: If you plan to team with another student, you need to discuss with your team-mate how you will allocate the work. There are two situations, depending on how soon your team is formed:

1. If you are able to team up before or shortly after the first day of class, I suggest you mutually agree on all the tasks that need to be done and decide how many hours each of you will spend on each of the tasks (don’t forget time to discuss/compare/review each other’s work). You will submit separate PWBSs that may have similar lists of tasks, but note that you and your team mate **should have different numbers of estimated and (later) actual hours for many of those tasks**. If your tasks and estimates are nearly all identical, it will indicate that you have not seriously planned/recorded your time.
2. If you do not team up until after you have completed the DRAFT PWBS, you need to do a **replan** once you have chosen a team-mate. This means you each turn in a DRAFT PWBS for assignment 1 at the end of the first week. Later, you decide to team with someone, so you meet with your team-mate and come up with a new plan, which may result in new estimates and possibly new or modified tasks. In this case you should notify the grader and instructor that this is your intention and send in the revised PWBSs when you turn in the INTERIM PWBS. As with situation #1, above, you and your team-mate **should have different numbers of estimated and (later) actual hours for many of those tasks**.

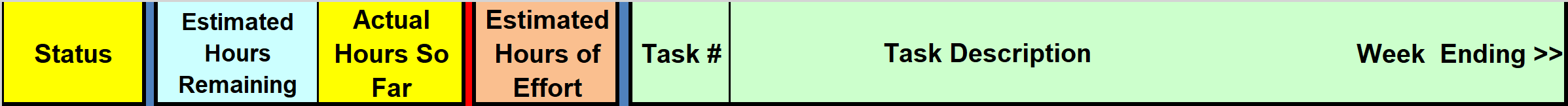
**Step b: Estimated hours of effort (record to the left of the WBS).**

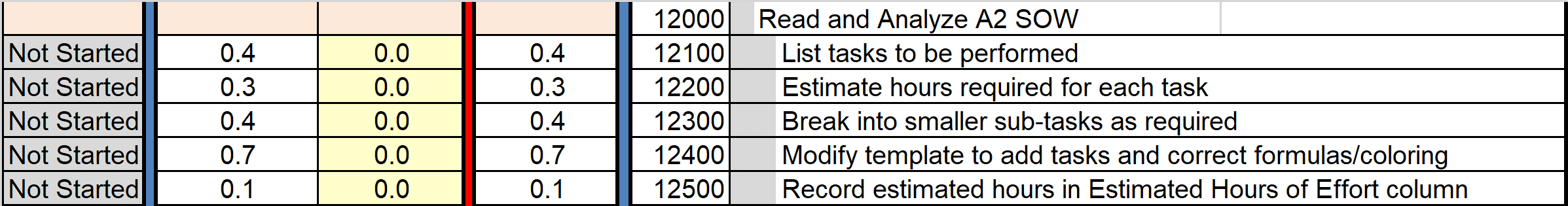
Estimate the effort, in hours, for each work task in your plan (if a task has sub-tasks, you should leave it blank – **only the lowest-level sub-tasks should have estimated hours of effort shown on the spreadsheet**). Place these initial estimates in two places:

1. the “**Estimated Hours of Effort**” column.
2. the “**Estimated Hours Remaining**” column (see step **c**).

If a task has an estimated time of more than 2 hours, consider breaking it into smaller sub-tasks. Note that you should make sure most of the lowest-level tasks are shorter than 2 hours and the higher-level tasks should have blank entries for estimated hours. Estimates may be specified in tenths of an hour, and many tasks will likely take less than an hour to perform.

**Figure 2** (below) shows an example of how a portion of the spreadsheet might look after you have entered the estimated hours of effort for a portion of the WBS showing the tasks (in assignment 1) that involve planning for the second assignment. Note that the hours shown are simply an example, not a recommendation. You must estimate your own effort.





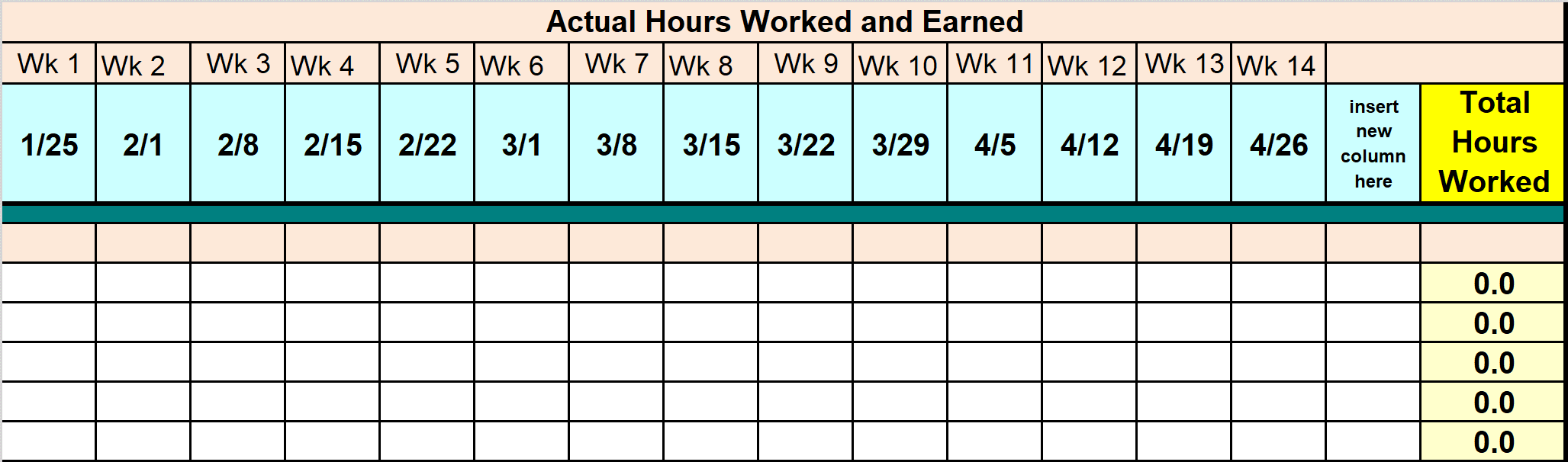
**Figure 2 – How the WBS might look after you have made your initial estimates.**

Steps “**a**” and “**b**” are done for all tasks of all assignments (i.e., for the whole course) as part of the first week’s work on assignment 1. Your DRAFT PWBS, which is submitted at the end of the first week, should show all tasks for all course assignments. Steps “**c**” through “**f**” are started in week 1, but updated each week throughout the semester.

***Special note***: once you have completed the initial estimate (and made any corrections based on the grader’s or instructor’s suggestions) *you should never change the number in the* ***Estimated Hours of Effort*** *column*. This column becomes your permanent record of your initial estimate of the work to be done. However, as you work on the various tasks you will change the numbers in the **Estimated Hours Remaining** column (see Step **c**).

By the time you have completed steps a-b, you will have finished constructing the **PWBS** workbook and, thus, you have a plan. Now it’s time to start using the workbook to track your progress against that plan. This involves steps c-f. The instructions below are to be followed at the end of each week.

**Step** **c**: **Actual Hours Worked and Earned.**



**Figure 3a – Actual Hours Worked and Earned – Initial Template**

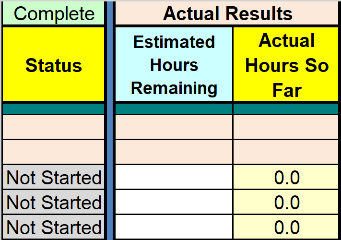
The right hand side of the **PWBS** sheet consists of a column for each week of the course, followed by a blank column (“insert new column here”), and a “**Total Hours Worked**” column at the far right. **Total Hours Worked** is the total of all hours worked on each task. Each week, you record the actual hours worked on each task in the corresponding column and row of the sheet. The totals are automatically updated. (Study the formulas to see how this happens. This might be on an exam!)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Actual Hours Worked and Earned** | | | | | | | | | | | | | | | |
| Wk 1 | Wk 2 | Wk 3 | Wk 4 | Wk 5 | Wk 6 | Wk 7 | Wk 8 | Wk 9 | Wk 10 | Wk 11 | Wk 12 | Wk 13 | Wk 14 |  |  |
| **1/25** | **2/1** | **2/8** | **2/15** | **2/22** | **3/1** | **3/8** | **3/15** | **3/22** | **3/29** | **4/5** | **4/12** | **4/19** | **4/26** | **insert new column here** | **Total Hours Worked** |
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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **0.5** |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **0.5** |
| **0.3** | **0.6** |  |  |  |  |  |  |  |  |  |  |  |  |  | **0.9** |
| **0.4** |  |  |  |  |  |  |  |  |  |  |  |  |  |  | **0.4** |

**Figure 3b – Actual Hours Worked and Earned – After Some Hours Have Been Recorded**

In Figure 3b, you can see that, in Week 1 of the course (the week ending 1/25), a student worked for 0.5 hours on the first task, 0.3 hours on the second task and 0.4 hours on the third task. The cells changed color when these values were entered to make it easy to see what tasks were worked on. The Total Hours Worked on the far right shows the total hours for each task. This student seems to have completed the first and third tasks, as there was nothing entered for Week 2 (the week ending 2/1). But for the second task the student worked an additional 0.6 hours during Week 2. Thus the Total Hours Worked shows the total for both weeks.

**Step d: Actual Results (to the left of the estimates).**

The leftmost column shows the **Status** of each task. Initially, all tasks are in the “*Not Started*” status, which means these tasks have not been started. When you start work on a task, as indicated by a number recorded in a weekly “**Actual Hours Worked and Earned**” column (step **c**), the “**Actual Hours So Far**” will automatically be updated to indicate the total hours you have worked on the task so far (counting all work in all weeks) and the “**Status**” of the task will automatically be changed to “*In Progress*”. [Suggestion: look at the formula in the “**Actual Hours So Far**” column to figure out how it automatically computes the correct total.]

If you have started work on a task but have not finished it by the end of the week, enter the hours you actually worked on the task in the **Actual Hours Worked and Earned** column for that week (see step **c**, above).

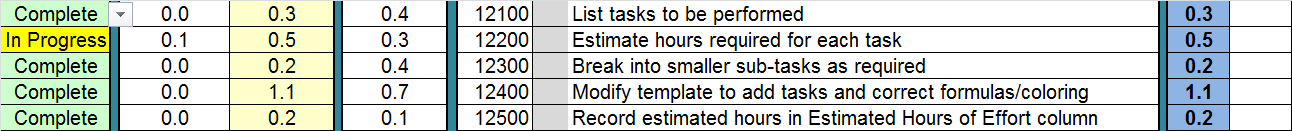
Suppose you estimated a task would take 1.5 hours and you worked on it for 1 hour, but you now think it will take another hour to complete. This is the purpose of the “**Estimated Hours Remaining**” column. Once you have entered the hours actually worked for a task (1.0 for this example) in the “**Actual Hours Worked and Earned**” column, you should examine the number in the **Estimate Hours Remaining** column for that task (1.5 for this example). Revise that number to reflect how much more time you think it will take to complete the task (1.0 in this example). This **Estimate Hours Remaining** number is typically revised each week and does NOT have to match the original **Estimated Hourse of Effort**. In fact, once you have started working on a task, it is very unlikely to match the **Estimated Hours of Effort** any more.

When you finish the task you should set the **“Estimated Hours Remaining”** to **zero.** When this happens the “**Status**” will change to “*Complete*”. Note also that once you complete a task you will have earned the number of hours you originally estimated for that task and must update the “**Hours Earned**” value (see step **e**).

**Figure 4**, below, illustrates how the above section of the spreadsheet might look at the end of the first week. Note that most tasks took a different amount of time than estimated, and all but one are complete.







**Figure 4 – Typical WBS at end of first week.**

In **Figure 4**, task *12100* was estimated to take 0.4 hours but was completed in 0.3 hours. Task *12200* was estimated to take 0.3 hours but you spent 0.5 hours on it and the task is still not complete – you believe it will require another 0.1 hours. The remaining three tasks are all complete, but in each case your estimated hours are not the same as the actual number of hours required.

The two **Actual Results** columns work together. The one with the white background is the “**Estimated Hours Remaining**” and the one with the yellow background is the “**Actual Hours So Far**”. Initially, before you have started working on the task, the “**Estimated Hours Remaining**” should be set equal to the “**Estimated Hours of Effort**” and the “**Actual Hours So Far**” should automatically calculate to 0. As you work on a task, at the end of each week, you should record the hours worked in the **“Actual Hours Worked and Earned**” section of the PWBS (right hand area with light blue headings). This will cause the indicated cell to change color, as shown above, and will automatically update the number in the yellow “**Actual Hours So Far**” column with the number of hours you have worked on the task. The number in the “**Estimated Hours Remaining**” column has a white background, which means that *you are expected to update this cell by hand each week*. It should be replaced with the number of hours you think are remaining to complete the task. For example [see the second line above, the one that says “*In Progress*”], if you spend 0.5 hours on a task, you record 0.5 in the “**Actual Hours Worked and Earned”** worked area and this will automatically add 0.5 to the “**Actual Hours So Far**” column. If you think there are 0.1 hours left, put 0.1 in the “**Estimated Hours Remaining**” column. [It is no longer necessary that you match the originally estimated hours from your first estimate. One of the purposes of this tracking system is to show how your actual results compare with your original estimate and, thus, where your original estimate was inaccurate. The “**Estimated Hours Remaining**” should always represent your best current estimate of the amount of time left to complete the work.]

Suppose you turn in assignment 1 at the end of week 1. Then, at a minimum, there should be numbers in most of the rows for the assignment 1 tasks for week 1 and most of those should have a status of “*Complete*”, with “**Estimated Hours Remaining**” of 0. All of the remaining tasks (the ones you have not yet started, such as the tasks for assignments 2, 3, and 4) should have an “**Estimated Hours Remaining**” equal to the “**Estimated Hours of Effort**” because you have not yet started working on those tasks. If you have started working on some of these other tasks but have not completed them, there should be a positive number in the “**Actual Hours Worked**” column and a positive number in the “**Estimated Hours Remaining**” column, and the **Status** should be “*In Progress*”.

The total of the “**Estimated Hours Remaining**” column (near the bottom left of the spreadsheet) should change each week, as you work on various tasks. **At the end of each week you must copy the total “Estimated Hours Remaining” (from the bottom of the WBS sheet) over to that week’s column** in the **“Actual Hours Worked and Earned”** section of the PWBS. See section **e.2**, below.

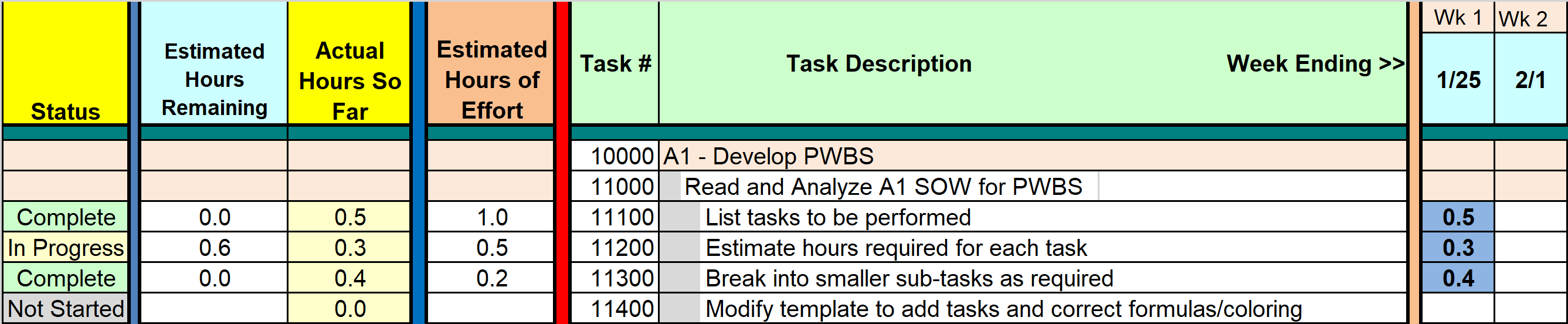
**Step e: Earned Hours (Tracking Progress).**

Imagine a student who worked hard every week but never passed a course. Such a student would not earn a degree – i.e., they would have worked hard but would not have “earned” anything. You “earn” something when you complete a task. Whereas “actual hours worked” is a measure of how hard you work each week, “earned hours” is a measure of how much you have completed each week. In order to compute earned hours, you need to do the following steps at the end of each week of the course. If you skip a week it will be harder to get the numbers correct.

**e.1 Identifying which tasks have been earned.** As described above, in step **c**, record all hours worked for the week in the “**Actual Hours Worked and Earned**” area and update the “**Estimated Hours Remaining**” for each task.

* If you have completed a task, you should set the “**Estimated Hours Remaining**” to 0. When that happens, the row for that task will be flagged as “*complete*”. That task has now been earned!
* All tasks you have started on but not completed will have positive numbers in “**Estimated Hours Remaining**” and will be flagged as “*in progress*”. Those tasks have not yet been earned.

In Figure 5, below, during Week 1, tasks 11100 and 11300 were earned. Task 11200 has not yet been earned. The amount that was earned is explained below in section **e.3**.



**Figure 5 – Which Tasks Have Been Earned?**

**e.2 Total Estimated Hours Remaining:** At the end of each week, after all hours worked have been recorded and **Estimated Hours Remaining** has been updated for all tasks you worked on that week, copy the “**Total Estimated Hours Remaining**” from the bottom left of the PWBS and paste it (as a *value* – “paste special” / “value”) into the “**Estimated Hours Remaining**”row (at the bottom of the WBS for the current week). This number will appear on the burn down chart for the corresponding week. *You must update this every week or the burn charts will be inaccurate.* See step **f,** below, for more information.)

**e.3 Earned Value (Hours Earned This Week):** Earned value is a record of how much work you have actually completed – i.e., how much you have earned.You can tell if you completed a task (and thus “earned” the estimated hours for that task) as follows:

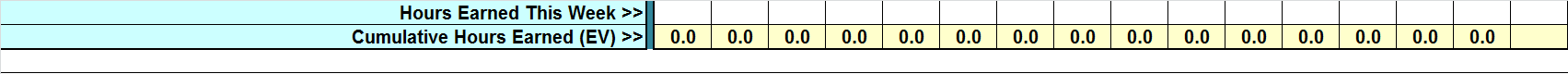
**Finding all the tasks that you earned this week.**

* Look down the **Actual Hours Worked and Earned** column for the current week and note all tasks you worked on.
* For each task you worked on, look to the left and see if the estimated hours remaining is 0 (in which case, the status should be *Complete*).
* If you did not complete any tasks this week, you do not need to do anything about computing the earned value. You did not “earn” anything this week so your earned value = 0 (you may have worked hard but you didn’t finish anything).
* If you *did* complete some tasks, you have earned the value of those tasks. For example, in Figure 5, in Week 1, you earned the value of tasks 11100 and 11300.

What you earn for completing a task is NOT the amount of hours you worked on it. The amount earned is the amount of hours you *estimated* it would take to perform that task. Why? Because you can think of your initial estimate as a firm bid that you made when someone asked you how much time it would take to do the task. Regardless of the amount of time it actually takes you to do the task, you only “earn” the amount you “bid” on the task.

**Determining how much you earned**.

* Do the following for each completed task: find the row for each task you have completed and write down the “**Estimated Hours of Effort**” value for that task. Add up all of the estimated hours for all tasks you completed this week – that is your earned value for this week. For example, in Figure 5, you earned 1.0 hours for task 11100 and 0.2 hours for task 11300, so your total earned value for the first week is 1.2 hours.
* Enter the earned value in this week’s column in the row “**Hours Earned This Week**” near the bottom of the WBS (step **f**).



That’s all you need to do, but you must do it each week. The earned value (EV) portion of the *earned value graph* is produced from the “**Cumulative Hours Earned**”row, which is the cumulative total of the “**Hours Earned This Week**” row.

You will notice that the template has two rows below “**Cumulated Hours Earned (EV)**”. These are labeled “**CPI**” and “**SPI**” and are computed automatically once you have entered the hours earned correctly. The meaning of these will be discussed during the class lectures.

**Step f – Remaining parts of the WBS.**

Here is a summary of the remaining parts of the WBS worksheet and what you must do with them.

**Rows at the Top**

**Top Row: Planned Effort**. Once you have determined how many hours you will spend on each task, which is recorded in the “**Estimated Hours of Effort**” column, this row will reflect when you should do all that work. In other words, how many hours you should spend on the course assignments each week (on average). The formula in this row assumes you will do the same amount of work each week. So it takes the total in the “**Estimated Hours of Effort**” column and divides by the number of weeks in the course. The template is set up to do this automatically and you may simply leave it alone, although you should look at the formula and understand how it works. You may also choose to adjust things up or down in certain weeks. For example, if you plan to spend less time during some weeks and more in other weeks, you might reduce or increase the **Planned Effort** numbers in those weeks. If you do this, make sure things add up to the correct total. If you do it correctly, the total in the far right of the **Planned Effort** row will match the total hours at the bottom of the **Estimated Hours of Effort** column. {There are more accurate ways of computing **Planned Effort** but they require a lot more work and add very little value to this method of tracking progress.}

**Second Row: Cumulative Plan** or **Planned Value (PV).** This is simply the cumulative total of the **Planned Effort** row. It is computed automatically and the total in the rightmost week’s position should match the total in the far right of the **Planned Effort** row. Note: the **Cumulative Plan** is very important. On the **Burn Up Chart** and the **Earned Value Chart**, the *Plan* line is a graph of this row.

**Third Row: Estimated Effort Remaining.** This shows the estimated number of hours of work that remain each week in order to finish all tasks, assuming you follow your plan exactly. In other words, it’s your *original estimate* of effort remaining. This is also calculated automatically from the first two rows (look at the formula in the template to see the calculation). This row becomes the *Plan* line on the **Burn Down Chart**.

Taken together, the first three rows of the sheet and the task and estimate information in the **WBS** constitute your plan. They show the work you plan to do and the amount of effort you plan to spend on that work each week. These rows will normally remain constant throughout the course, once you have completed your initial estimate (steps **a** and **b**) and made any corrections based on comments from the grader or instructor.

**Rows at the bottom**



**Figure 6 – Rows at the bottom of the WBS worksheet.**

**Total Actual Hours Worked**: This is the sum total of all rows in the **Actual Hours Worked and Earned** portion of the worksheet. This value shows, each week, how many total hours you actually worked on the various tasks. It is calculated automatically, provided you enter the hours correctly. Note that if you compare this number with the corresponding number at the top (**Planned Effort**), you can tell how your actual work compares with your original plan. It is not necessary that these numbers match exactly, but if you are consistently doing less work than your plan, it may indicate that you are not keeping up.

**Cumulative Actual Hours** or **Actual Cost (AC):** This is simply the cumulative total of the **Total Actual Hours Worked**, and is computed automatically. It shows the total amount of work you have spent on all tasks since the beginning of the semester. You should not normally have to adjust this formula. This number is displayed on the earned value graph.

**Estimated Hours Remaining:** *This is shown in red as a reminder that you must enter the data for this row at the end of each week* (see step **e**, above). This number is obtained by copying the number from the total of the **Estimated Hours Remaining** column (at the bottom left of the **PWBS** sheet). **You must do this each week** at the end of the week, as described above in step **e.2**. If you fail to do this, it may mess up your graphs. **Special note: copy and then paste the “*value*” of the number. Otherwise, Excel will paste a formula, and that would give you the wrong number. See the “paste special” option under the *Paste* function in Excel.**

**Hours Earned This Week:** This was discussed above in step **e.3**. *It is shown in red as a reminder that you must enter the data for this row at the end of each week.*

#### General Notes

It will be worth your time to figure out how each part of the spreadsheet works, how each line on each graph is calculated, how each formula works, etc. Spreadsheets like this are an important tool for any professional software developer, especially team leaders, and an essential tool for anyone doing software metrics. The midterm and final exam may contain questions about different parts of the PWBS spreadsheet!

**New Tasks and Inaccurate Estimates.** As you proceed through the semester, you are likely to learn two things: a) that you underestimated or overestimated the work required to perform some tasks; b) that you overlooked some of the work and need to add new work tasks. That’s OK – these kinds of changes are expected on any project, especially medium to large sized projects. One advantage of a tool like the PWBS is that you can easily see where your estimates were inaccurate and take appropriate action.

1. **Incorrect Estimates.** Incorrect estimates are expected and the PWBS is designed to deal with them. On any real software development project, many estimates will be inaccurate. Although you want to be accurate when making estimates, it is even more important to keep track of your inaccurate estimates and to know how inaccurate they are. This is the purpose of the “**Estimated Hours Remaining**” column and row. Always record the actual hours spent each week and update the “**Estimated Hours Remaining**” each week with your best available information. When you do this, the *burn down chart* will show you how you are doing relative to your plan. Once you have completed the task, the difference between the **“Estimated Hours of Effort”** and the **“Actual Hours So Far”** tells you how accurate (or inaccurate) your original estimate was, for that work task. This serves two purposes:
   1. It helps you estimate similar work tasks more accurately on your next project.
   2. It helps you determine if your project is running ahead of or behind schedule and allows you to make appropriate adjustments in your work plan. For example, if you determine that you are running behind schedule on most tasks, it tells you that you probably need to allocate more time to get the rest of the work done by the project deadline.

When the PWBS is graded, you will not lose any points for inaccurate estimates unless it is apparent that you did not make a serious attempt at estimating. We expect you to have some inaccurate estimates (but we expect them to be honest estimates). You will be graded on whether you make serious attempts to estimate correctly and whether you track what really happens properly.

1. **New Tasks.** If you decide you must perform a new, unplanned work task, insert it as a new row in the **WBS** worksheet. Indicate an “**Estimated Hours of Effort**” of “0” hours for that new task, but put your real estimate of the hours required in the “**Estimated Hours Remaining**” column. As you work on the new task, record the hours worked each week and update the “**Estimated Hours Remaining**” as well. Note that even when you complete this new task, your “*earned*” hours will be 0. You don’t earn any credit because new tasks are treated as extra work that was not included in your original plan.

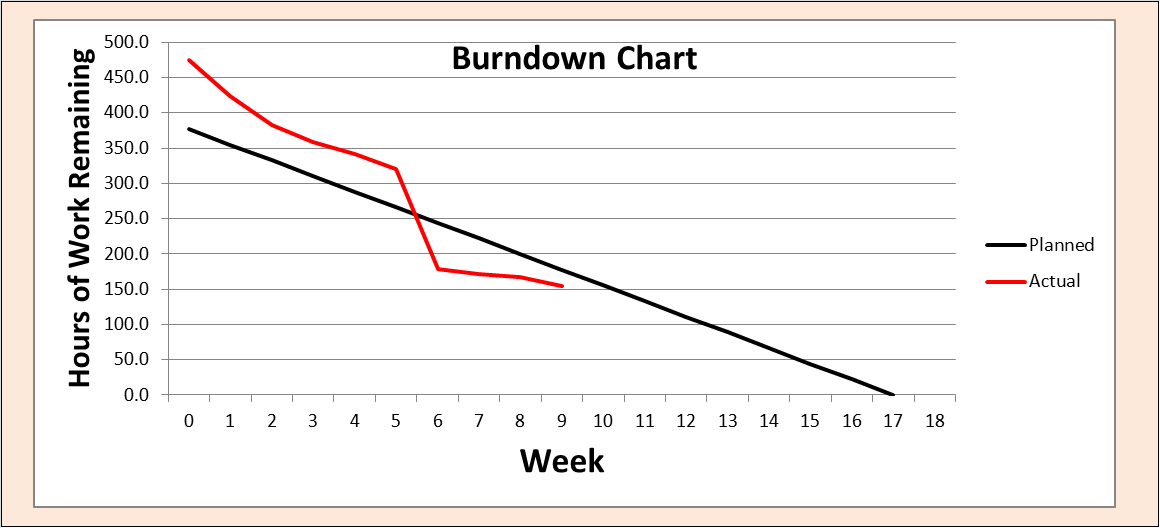
**Inaccurate list of tasks.** When you prepare your plan for the DRAFT PWBS you will have to estimate what tasks you will perform and how long each will take. Since you have not taken this course before, you will probably be inaccurate with some of the tasks. You will NOT be graded on accuracy of your estimate, provided you have made a serious and honest attempt to estimate. You will be graded on completing the worksheet properly to represent your estimate and, later, recording your actual results correctly. I expect some of your “actual” numbers to differ from your estimates and I won’t be surprised to see a few new tasks added to some worksheets. That’s part of the technique!

On the other hand, this does not mean I expect you to estimate poorly in the first week and then make up for the inaccurate estimate by adding many new tasks every week. I expect a good-faith effort to estimate correctly during week 1. You have enough information available to do so. (It’s also a lot more work and more likely to generate errors if you update the WBS with new tasks each week.)

#### Graphs (Charts)

There are five charts (or graphs) shown on their respective tabs of the workbook – a burn down chart, a burn up chart and three earned value charts.

**Burn down chart**: This chart, which has two thick lines, shows how much work is left to do each week. The thick black line (derived from the “**Estimated Effort Remaining**” row near the *top* of the WBS worksheet) shows the original plan. The thick red line (from the “**Estimated Hours Remaining**”row at the *bottom* of the WBS worksheet) shows what is actually happening. A burndown chart is a very simple way to show the progress of your project and to estimate how much longer it is going to take. Burndown charts are widely used in agile development projects and other adaptive and iterative developments as well as on smaller projects using non-agile techniques. They are relatively easy to construct and they give a good perspective on the status of the project.

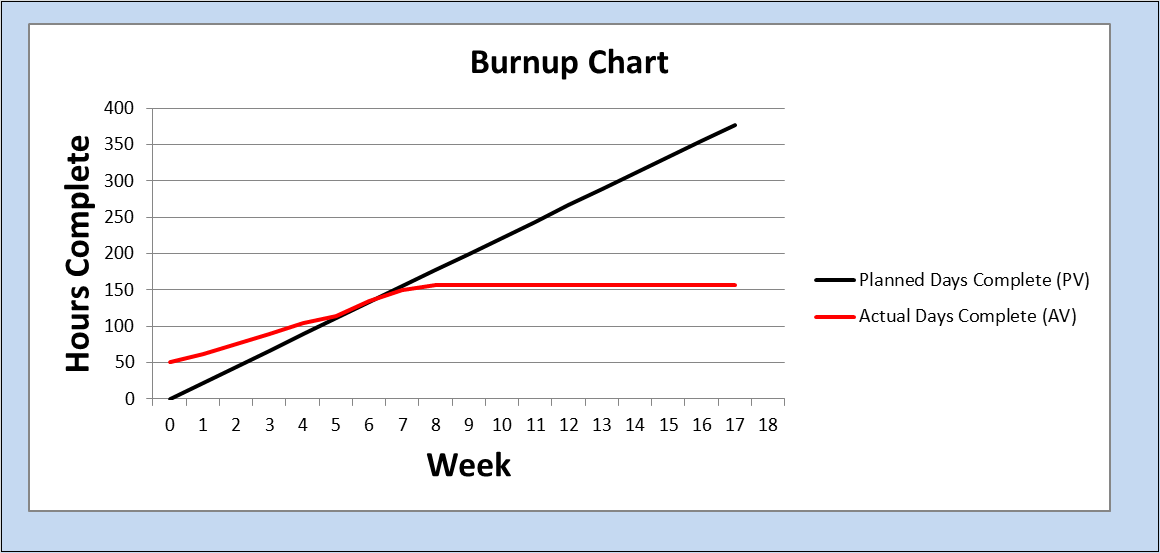


In the above burn down chart, the project was somewhat behind for the first five weeks, but suddenly got caught up in week 6. This may be due to a change in the scope of some of the work tasks or it could be the result of an extraordinary effort on the part of the software developers in week 6.

**Burn up chart**: This chart, which also has two thick lines, also shows how much work is left to do each week. The thick black line (derived from the “**Cumulative Plan**” row near the *top* of the sheet) shows the original plan – how much work you planned to complete each week. The thick red line (from the “**Cumulative Actual Hours**” row at the *bottom* of the sheet) shows what is actually happening. A burnup chart is another simple way to show the progress of your project and to estimate about how much longer it is going to take. Burnup charts are also widely used in agile development projects and other adaptive and iterative developments as well as on smaller projects because they are relatively easy to construct and they give a good perspective on the status of the project. If your original estimates were inaccurate, burn up charts are considered more helpful than burn down charts at helping you estimate how much extra work you have to do before you finish.

You can judge for yourself whether you find the burnup or burndown chart more helpful. There will be some discussion of these charts in the class lectures.

In the burnup chart shown below, the project started off (ahead of plan) but slowed down and is now slightly behind schedule. (The horizontal line for the **Actual** value simply indicates that if no more work is done, this is as far as the project will be at the end.)



**Earned Value charts:** These charts will be easier to understand after the earned value technique is discussed in the class lectures. The first chart, a form of burn up chart, is a bit more sophisticated than the simple burnup chart, and is commonly used on very large projects. The earned value line chart has three lines:

The thick black line is **PV** or **Cumulative Plan**, recorded each week (i.e., the cumulative total of the “plan” values from week 1 up through the current week). This is derived from the “**Cumulative Plan**” row at the *top* of the worksheet. It represents your plan for completing the work on the project and is identical to the plan line on the burnup chart.

The thick red line is **AC** or **Actual Cost**, recorded each week (i.e., the cumulative total of the “actual” values from week 1 up through the current week). This is derived from the “**Cumulative Actual Hours**” row near the *bottom* of the worksheet. It is identical to the **actual** line on the burnup chart. It shows what amount of effort (work) has actually been performed, but does not say how much of the work is complete.

The thick green line is the **EV** (Cumulative Earned Value), recorded each week (i.e., the cumulative total of the “earned” values from week 1 up through the current week). This is derived from the “**Cumulative Hours Earned**”row at the *bottom* of the worksheet. This line shows how much work has been completed or earned. The amount of credit given for an “earned” task is the *original estimate*, regardless of whether the actual hours spent on the task is larger or smaller than this. Earned value is a valuable thing to measure because it helps you judge, on an overall basis, whether you have over- or under-estimated the amount of work required to do the project.

On an ideal project, all three lines on the earned value graph would be the same. But no project is ever ideal. As you proceed through the semester you might want to watch all of the graphs and it would be a good idea to examine them closely to see how they are constructed.

Here is a sample of what an earned value graph would look like:



The above graph shows an eleven week project at the end of week 8. The graph suggests the project had a highly ambitious plan (black line) but has only been able to spend about half as much effort as planned (red line). To their credit, they have accomplished (green line) approximately as much work as their level of effort suggests, meaning that they estimated reasonably accurately, but did not have enough people (or spend enough time) on the project. If this graph represented a student’s PWBS it would indicate a student who estimated the tasks accurately but was not spending enough time on the course assignments.

**Performance Indices (SPI and CPI)**

The two remaining graphs in the earned value section are the SPI and CPI charts. SPI is Schedule Performance and CPI is Cost Performance. These will be discussed in the class lectures, but if you look them over you will probably get a good idea of what they are telling you. The black “goal” line is where you want to be. The other line is where you actually are. If the “where you are” line is above the black line you are ahead of schedule or under budget (i.e., things are going well). If the “where you are” line is below the black like, you are behind schedule or over budget (i.e., things are not going well).

#### \*\*\*\* Note on grading of the PWBS \*\*\*\*

The DRAFT version of the PWBS will be evaluated with feedback to you at the end of week 1. The evaluation will not affect your grade. However, you should heed what you are told and make any corresponding corrections or changes to your PWBS.

The INTERIM version will be graded at the end of week 3 and the FINAL version at the end of the course. The grading will be based on how seriously you have planned the course and tracked your progress. Here are some of the things that will result in points taken off of your assignment:

* Not having enough tasks and subtasks (in other words, not providing enough detail to constitute a serious plan)
* Not using a hierarchy of tasks where it makes sense to do so
* Having unrealistic estimates of the hours required for each task (for example, making them all exactly 2 hours)
* Failure to record the actual hours each week
* Failure to record the earned hours each week or failure to record the earned hours properly
* Failure to record/update the “estimated hours remaining” for tasks you work on each week
* Failure to copy the “estimated hours remaining” to the appropriate place at the end of each week
* Charts (graphs) make no sense because you did not record the correct information each week
* Totals don’t make sense (this usually happens because you modified formulas incorrectly or you failed to record hours correctly or you inserted new task rows but did not use the correct formulas)

#### Appendix B

#### Alternative WBS Task Numbering Approaches

#### In a work breakdown structure, the task number is a way to show three things:

#### A unique identification number for each task

#### The order of the tasks

#### The hierarchy of the tasks (i.e., which tasks are sub-tasks of others)

#### Two of the most commonly used WBS task numbering systems are shown below:

|  |  |  |  |
| --- | --- | --- | --- |
| System | Example | Advantages | Disadvantages |
| Dot for each level of hierarchy (paragraph notation) | 1. Top Level   1.1 First item at second level  1.2 Second item at second level  1.2.1 First item at third level  1.2.2 Second item at third level  1.3 Third item at second level  …  Sometimes these are indented:  1.0 Top Level  1.1 First item at second level  1.2 Second item at second level  1.2.1 First item at third level  1.2.2 Second item at third level  1.3 Third item at second level  … | * Can allow an arbitrary number of levels * Can allow an arbitrary number of tasks at any level * Widely used for large work breakdown structures | * Harder to use for sorting (some sorting tools will not sort these in the proper order) |
| Each Digit corresponds to a level | 100000 Top level item  110000 First item at second level  120000 Second item at second level  121000 First item at third level  122000 Second item at third level  130000 Third item at second level  This can also be indented. *The WBS template uses an indented form of this system.* | * Can be used to sort the tasks into the proper order * Convenient to use for small WBSs | * Allows only ten tasks at any level * Number of levels is limited to the number of digits initially set up (six in the case of the WBS template) |

For purposes of assignment 1, the numbering system you use is not important. So you may use a different one if you wish. You could use the first method (with the dots), but most students will use a variation of the second method. Here are some commonly encountered situations and how you might be able to handle them if you start with the second method:

|  |  |  |
| --- | --- | --- |
| **Problem** | **Suggested Approach** | **Example** |
| You have more than ten tasks at a given level | Use two digits for tasks at that level (you only need to do this for the specific situation where there are more than ten tasks) | 200000 Top level task for assignment 2 201000 First sub-task for assignment 2  202000 Second sub-task for assignment 2  … 215000 Fifteenth sub-task for assignment 2 |
| You have more than ten top level tasks | Use the first two digits for the top level tasks | 010000 Top level task for assignment 1 020000 Top level task for assignment 2  … |
| You have more than six levels | Use extra digits as needed | 10000000 Top level task for assignment 1 …  20000000 Top level task for assignment 2  …  (adding two extra digits allow two extra levels) |

#### [cover sheet – this is a reproduction of the cover sheet found as the leftmost tab in the PWBS template. It is shown here for your information, but you should use the one in the template. Fill in all bold, underlined sections with your specific information.]

ASSIGNMENT 1

1

#### DO INITIAL VERSION OF PERSONAL WBS

**CSE 6329**

**PLANNING AND MANAGING A SOFTWARE PROJECT**

***Fall, 2019***

Professor Dennis J. Frailey

NAME \_\_**<*Your Name Goes Here>***\_\_\_\_\_\_ STUDENT ID NUMBER \_***<id# Goes Here>***\_

THIS COVER SHEET SHOULD APPEAR AS THE FIRST PAGE.

Grading template Student do not write inside this box

WBS (100 points) \_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_ Correct Format, including name on top, totals, etc. (10 points)

\_\_\_\_\_\_\_\_\_\_ Reasonable list of tasks (50 points)

\_\_\_\_\_\_\_\_\_\_ Reasonable estimates of time for each task (30 points)

\_\_\_\_\_\_\_\_\_\_ Proper recording of actual and earned hours in first week,

including proper updating of estimated hours remaining.

\_\_\_\_\_\_\_\_\_\_\_/100 Total Assignment Grade

Comments from Grader

*(comments go here)*

Note: if you receive comments on your DRAFT PWBS, make

the indicated corrections and delete the grader comments on

your INTERIM PWBS.

If you receive comments on your INTERIM PWBS, make

the indicated corrections and delete the grader comments on

your FINAL PWBS.