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| **Assignment 3 (Team Project I) - 100 pts**  **Due Date: See Timeline and Deliverables** |

## Background and Objectives

One of the most promising source of energy is from the sun. The promise of clean, cheap, and abundant electricity from the sun has been the dream of many scientists and businesses.

The solar radiation (sun) is converted into electricity using a device called Photovoltaic (PV) module or panel.

A PV module is characterized by its performance output parameters. The methodology for the investigation of PV modules performance requires the measurement of current-voltage (I-V) characteristics. I-V data form the basis for studying the electrical characteristics of a PV module.

PV modules performance characteristics are often reported at standard test conditions (STC). Thus, data collected in the field (a.k.a. Actual Test Conditions or ATC) must be translated into STC.

The objectives of this project is to use UNIX scripting to translate field performance data into STC and present the results into a specific reporting format.

## Data

Each team will be provided with a set of data.

The data consist of 3 curves.

Each curve provides values for the following parameters:

* Curve name (curves)
* Date the data was collected (dateMeas)
* Time the data was collected (timeMeas)
* Ambient temperature (Tamb)
* Reference cell temperature (Tref)
* Module temperature (Tm)
* Irradiance (irradiance)
* Short-circuit current (Isc)
* Open-circuit voltage (Voc)
* Current at maximum power (Imp)
* Voltage at maximum power (Vmp)
* Fill-factor (FF)
* Maximum power (Pm)

These variables must be local to the bash login shell, except the ***Module temperature***, which shall be set as an environment variable.

## Translation

**Step 1: Simple Assignments**

The data files are not editable. This is to prevent you from copying and pasting (UNIX doesn’t like that!).

As the first step, you need to create the necessary variables and assign their respective values as shown on the figures below.



Each parameter must be created as an array or list of 3 elements.

For example, the first parameter, Curve Name, would be created as:

*declare -a curves*

*curves[0]=”bps7989x”*

*curves[1]=”bps7989y”*

*curves[2]=”bps7989z”*

**Step 2: User Inputs**

Two set of inputs are required from the user: reference cell characteristic (ref) and the module temperature coefficients (tempcoef). The reference cell characteristics have two numbers: the first one is the reference cell calibration factor (CFref) and the second one is the reference cell temperature coefficient (TCref).

The module temperature coefficients have three elements of interest:

Temperature coefficient for voltage (v1)

Temperature coefficient for maximum voltage (v2)

Temperature coefficient for FF (f)

Temperature coefficient for power (p)

Write a function to obtain these parameters from the user and assign them to their respective variables.

The Korn shell’s **read** command can be used for that purpose (see P.247).

So your function should execute the read command from a child Korn shell, obtain the values from the user and assign them to their appropriate variables; then set those variables to be environment variables so they can be used in the parent shell. Your read command should display a descriptive prompt so that the user knows what to enter.

**Step 3: Functions to translate parameters to STC**

Now you need to write the following functions to translate the different performance parameters:

Function to compute the irradiance at STC.

This function should accept the ***irradiance*** and the ***Tref*** parameters and return the irradiance at STC, named ***STCIrradiance*** and defined by the formula below:

Function to compute maximum power at STC:

This function should also accept two parameters: Pm and STCIrradiance; then compute and return the maximum power at STC (STCPm) defined as:

Function to compute open-circuit voltage (STCVoc), maximum voltage at STC (STCVmp), and fill-factor at STC (STCFF):

These parameters can all be computed by a single function definition.

The formula are as followed:

The rest of the parameters, namely short-circuit current at STC (STCIsc) and maximum current at STC (STCImp), can either be computed from the main script and within a function call as well. I’ll let this design decision up to you.

They are defined by the formula below:

**Step 4: Averages**

The performance parameters at STC are reported as an average of the 3 curves.

Write a function that takes 3 parameters, compute and return their average.

**Step 5: Main script**

Your main script should process the data in the order above, using appropriate variable names. Make extensive use of comments to make it easier to follow your code and share among team members.

## Result Display

Once you are done with the translation, the result must be displayed as shown below. Temperature coefficient for current was not requested and should display no value.

Measured @ ATC refers to the actual field data provided to you, except that the values displayed should be averages. Module temperature at STC is fixed and is 25. Ambient temperature at STC should be left blank. In the Date column, for the “Measured at STC”, display the current **date** in the format shown.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Date** | **Isc** | **Voc** | **Imp** | **Vmp** | **FF** | **Pm** | **Tamb** | **Irradiance** | **Tm** |
| **Measured @ STC** | 2/11/2014 | 20.2 | 22.3 | 4.40 | 17.5 | 70.6 | 77.1 |  | 1014.8 | 25 |
| **Measured @ ATC** | 2/19/2001 | 8.34 | 36.80 | 7.71 | 29.80 | 74.86 | 230.00 | 29.8 | 1015.0 | 23.6 |
| **Temp. Coef** |  |  | -0.1273 |  | -0.1330 | -0.1252 | -1.0481 |  |  |  |

## Timeline and Deliverables

Deliverables are to be submitted electronically through Blackboard. When your team is ready for submission, alert the instructor for case testing. This is a necessary step. No deliverable will be considered without case testing.

The header of your deliverable should be in the following format:

***Course Id****: CST 383*

***Team Identification****:*

***Team Members****:*

*Member 1 full name:*

*Member 2 full name:*

*Member 3 full name:*

*Member 4 full name:*

***Project Deliverable****: Assignment 3 (Team Project I): <Deliverable title>*

Example: For the first deliverable, **Assignment 3 (Team Project I): Variables Assignments**

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| Deliverable title | Due date | Worth |
| Variables Assignments  (Step 1 & 2) | 2/25/14 by midnight | 40 PTS |
| Function Definitions  (Step 3 & 4) | 3/4/14 by midnight | 20 PTS |
| Final Report | 3/18/14 by midnight | 40 PTS |