# Purdy's Computerized Training Program

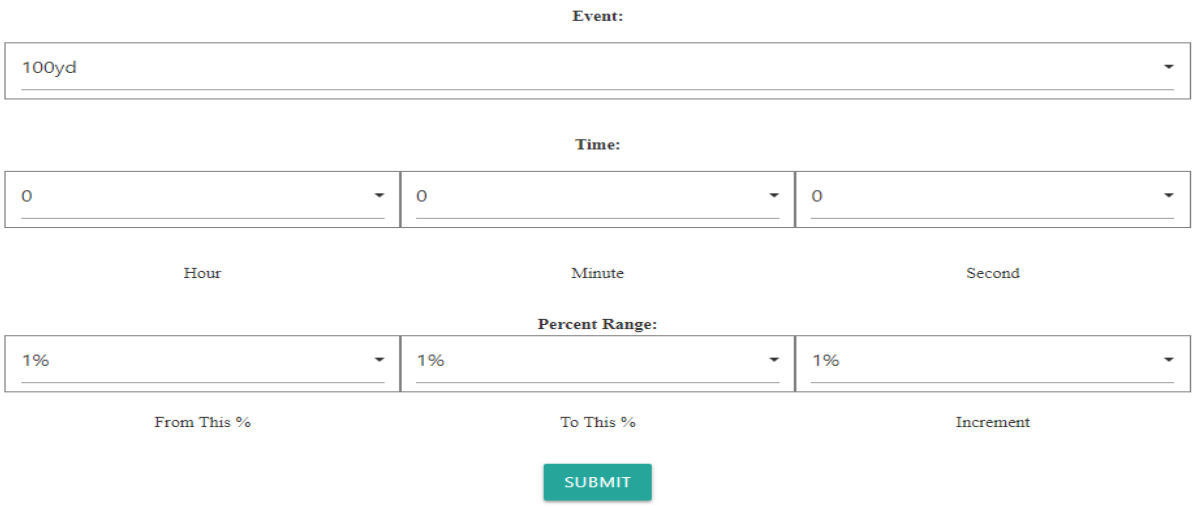
## Description

This program was developed for coaches or runners alike so that they have the ability to input their running information into one program and thereby retrieve a table that shows what a runner should be able to run for any event given their abilities. It also allows for the percentage of effort, "Performance Percentage", to be manipulated and give coaches and runners the edited times for a "less-exerting" workout. The program works with multiple running events, being distance or sprint, relay or hurdle, the calculations match up despite the non-linearity of different events.

## Example

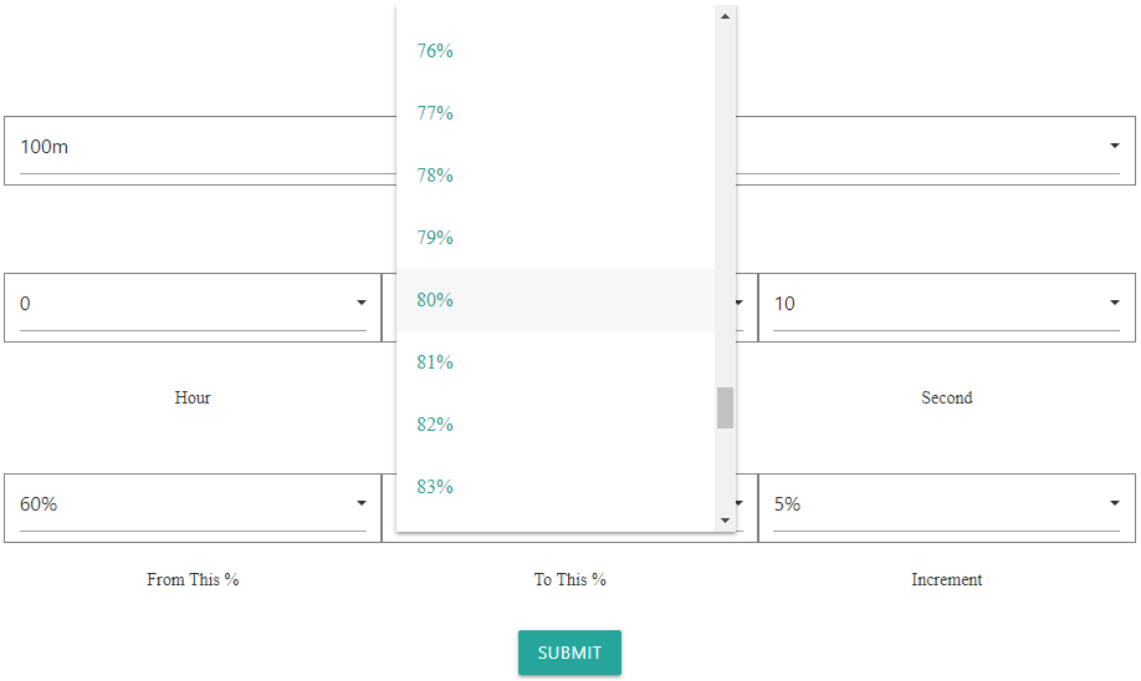
The following is an example of how a coach would use the program to direct his/her runner on a workout for the day:

1. The coach starts up the program and is shown the drop down boxes




*Drop-down Boxes for Event, Time and Percent Range with Submit Button*

2. The coach inputs his/her runner's event, 100 meter dash, as "100m"; the runner's time, 9.8 seconds, as "10 (seconds)"; and the desired percentage range for the exertion level s/he picked that day, 60% to 80% by 5% intervals, as "60% (From this %)" "80% (To This %)" "5% (Increment)"




*Selection of Specified Coach Inputs into Dropdown Boxes*

3. The coach hits the submit button and the table is generated/shown as output, with the ability to scroll down through all the events. The coach now has the times his/her runner should complete a distance in for a number of repetitions the coach picks with discretion to future events/trials/etc.

SUBMIT

| Distance | 60% Performance | 65% Performance | 70% Performance | 75% Performance | 80% Performance |
|---|---|---|---|---|---|
| 100yd | 15.461 sec | 14.272 sec | 13.253 sec | 12.369 sec | 11.596 sec |
| 100m | 16.667 sec | 15.385 sec | 14.286 sec | 13.333 sec | 12.5 sec |
| 200m | 33.323 sec | 30.76 sec | 28.562 sec | 26.658 sec | 24.992 sec |
| 400m | 1 min 14.943 sec | 1 min 9.178 sec | 1 min 4.237 sec | 59.954 sec | 56.207 sec |
| 800m | 2 min 53.254 sec | 2 min 39.927 sec | 2 min 28.504 sec | 2 min 18.604 sec | 2 min 9.941 sec |
| 1500m | 5 min 57.828 sec | 5 min 30.303 sec | 5 min 6.71 sec | 4 min 46.262 sec | 4 min 28.371 sec |
| One Mile | 6 min 26.901 sec | 5 min 57.14 sec | 5 min 31.63 sec | 5 min 9.521 sec | 4 min 50.176 sec |
| 5000m | 22 min 3.26 sec | 20 min 21.47 sec | 18 min 54.223 sec | 17 min 38.608 sec | 16 min 32.445 sec |
| 10000m | 46 min 13.962 sec | 42 min 40.581 sec | 39 min 37.682 sec | 36 min 59.17 sec | 34 min 40.472 sec |
| Marathon | 3 hour 37 min 14.473 sec | 3 hour 20 min 31.822 sec | 3 hour 6 min 12.406 sec | 2 hour 53 min 47.579 sec | 2 hour 42 min 55.855 sec |

*Table of Times for Events Ran at 60% to 80% Pacing of Best Time*

## Motivation

The motivation behind the creation of this program is to provide a simple program to our client and mentor: Michael Stahr. This project was meant to also count towards credit of the completion of the Computer Science Senior Design Project/Capstone requirement for graduating from Miami University of Ohio.

## Purdy Research - How It Works

The program works based on the idea of Dr. Gerry Purdy's formula for defining a level system; that when given a velocity for a given event, a value is set for that performance. The formula found to solve this is as follows:

$$P = C_1 (M - z) + C_2 (e^{C3(M-z)} - 1)$$

Where:

- P = Purdy Points (what is trying to be found)
- $C_1$, $C_2$, and $C_3$ = These constants were found to equal constants found for the 500, 1100, and 1400 Purdy Point levels that were then normalized to the 1400 Purdy Point level in order to reconcile very large values. The values are found in the table shown below.

| EVENT | $C_1$ | $C_2$ | $C_3$ |
|---|---|---|---|
| 100 yd | 851.88528 | 1.1643153 E−03 | 16.72092 |
| 100 m | 839.75428 | 3.1833857 E−03 | 15.415497 |
| 200 m | 881.70483 | 1.4162419 E−02 | 13.487407 |
| 400 m | 1047.9015 | 2.1175050 E−05 | 22.084218 |
| 800 m | 1131.6133 | 8.4512363 E−07 | 27.394097 |
| 1500 m | 1164.4589 | 2.3040003 E−04 | 20.538790 |
| One mile | 1168.6261 | 3.5898808 E−04 | 19.974554 |
| 5000 m | 1179.3839 | 2.6071613 E−03 | 17.831672 |
| 10000 m | 1152.9698 | 1.1470485 E−02 | 15.899776 |
| Marathon | 1195.5466 | 6.7257161 E−02 | 12.725493 |
| 110 m HH | 915.40060 | 7.7499020 E−02 | 12.025866 |
| 400 m IH | 911.61065 | 9.2208460 E−02 | 11.805470 |
| 3000 m SC | 1381.5344 | 2.1066044 E−02 | 14.743573 |
| 400 m R | 879.66309 | 1.7573247 E−03 | 15.941420 |
| 1600 m R | 939.19286 | 5.5475673 E−03 | 15.054013 |
| High Jump | 1628.6633 | 2.2572603 E−03 | 18.363365 |
| Pole Vault | 1209.5647 | 5.6711223 E−02 | 10.225523 |
| Long Jump | 1141.7440 | 2.8924221 E−03 | 13.404993 |
| Triple Jump | 1309.3753 | 2.8496697 E−06 | 22.407650 |
| Shot Put | 1001.1731 | 7.7887132 E+00 | 4.2556778 |
| Discus | 1067.8118 | 1.4504505 E+00 | 5.8442144 |
| Hammer | 1080.2544 | 1.0144750 E+00 | 6.1872162 |
| Javelin | 1030.1710 | 6.2638991 E+00 | 4.4074288 |

NOTE: Constants assume normalized values for the performance marks, i.e., each performance must be divided by the 1400 point level performance before the scoring equation is evaluated to determine the point score. See text for further explanation. Values are listed with the necessary significant digits to retain precision in the numerical evaluation process.

*Normalized Constants for Each Event*

The following excerpt is directly from Dr. Purdy's work in an attempt to show some insight on how these values came to be:

> *"...equations for $C_1$, $C_2$, and $C_3$ are computed iteratively by the Gauss-Seidell technique with initial values of 1.0 for the constants. Equation 2 is solved with the initial value of $C_2$ and $C_3$. Equation 3 is solved with the initial value of $C_3$ and the new value of $C_1$. Finally, Equation 4, is solved with the new values of both $C_1$ and $C_2$. These equations can be computed iteratively until the new values do not change substantially from the old ones. The main problem with this method is that converging to a final value for the constants tends to be a very slow process. When a small correlation is made to the constants, the next change is even smaller, and so on. Another method can be employed that will speed up the process. It is the method of Marquardt. This method uses the partial derivatives of the function equation, which in this case means the partials of Equation 1 with respect to the three constant parameters at each of the three known point levels (3 constant parameters, 3 known point levels, 9 partial derivatives). This algorithm requires good estimates of the constant parameters so that the initial values of the derivatives do not send the solution off in the wrong direction resulting in a divergence of the solution. The above Gauss-Seidell method gives the required first-level approximations...then used the Marquardt method to optimize the constant values."*

- M = Performance **M**ark, the Velocity the program will calculate based on the user's entries for event and time, normalized (i.e. divided) by the 1400 Purdy Point level.
- z = Zero Offset, the Velocity that is set for each event given a Purdy Point level of zero, normalized (i.e. divided) by the 1400 Purdy Point level.

## Contributors

The following people contributed to the creation of this program:

- Arianna Bryant - Developer
- Jinxian Zhu - Developer
- Binpeng Liu - Developer
- Zengzhi Jiang - Developer
- Michael Stahr - Data/Information Provider and Mentor/Client