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Test Runs

EEEE4115 - ACE

➢ Basic tests

Note: For visual clarity, the tests in this section are conducted on an array of 5's rather than an array of random integers.
The final section of this document will demonstrate the required operation of the application on an array of randomly generated 1 digit integers.

```
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpicc -o output prefix.c

youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 8 ./output
Enter the number of terms: 8
Initial elements of array: 5 5 5 5 5 5 5 5
Final elements of array :  5 10 15 20 25 30 35 40
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$

youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 16 ./output
Enter the number of terms: 16
Initial elements of array: 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Final elements of array :  5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$

youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 32 ./output
Enter the number of terms: 32
Initial elements of array: 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Final elements of array :  5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$
```

Figure 1: 5x8=40, 5x16=80, 5x32=160

➢ Extended testing

```
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 64 ./output
Enter the number of terms: 64
Initial elements of array: 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Final elements of array :  5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225
230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$

youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 128 ./output
Enter the number of terms: 128
Initial elements of array: 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Final elements of array :  5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225
230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460
 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$

youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 256 ./output
Enter the number of terms: 256
Initial elements of array: 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
Final elements of array :  5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225
230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460
 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 69
5 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 9
30 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 11
30 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 1235 1240 1245 1250 1255 1260 1265 1270 1275 1280
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$
```

Figure 2: 5x64=320, 5x128=640, 5x256=1280

➢ Special Cases

- **Number of Terms < Number of Processors**
  Automatic padding of the remaining processor values to zero.

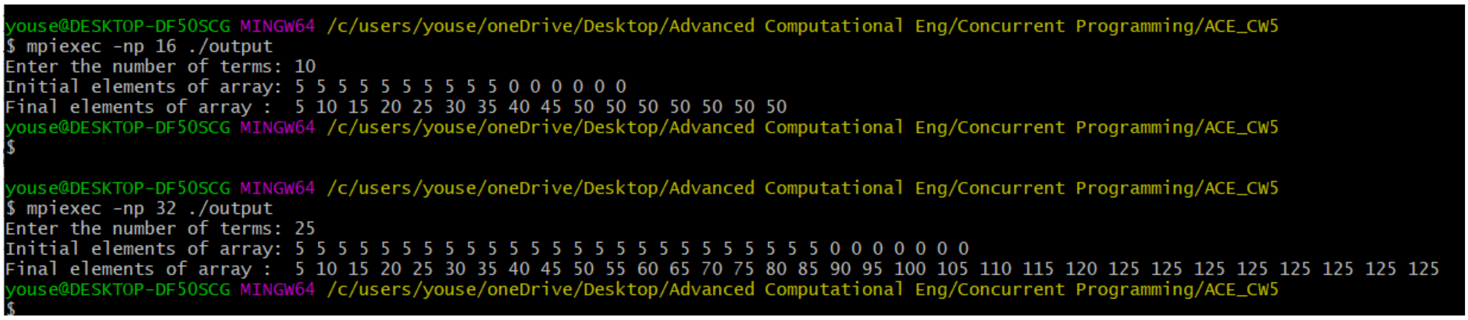
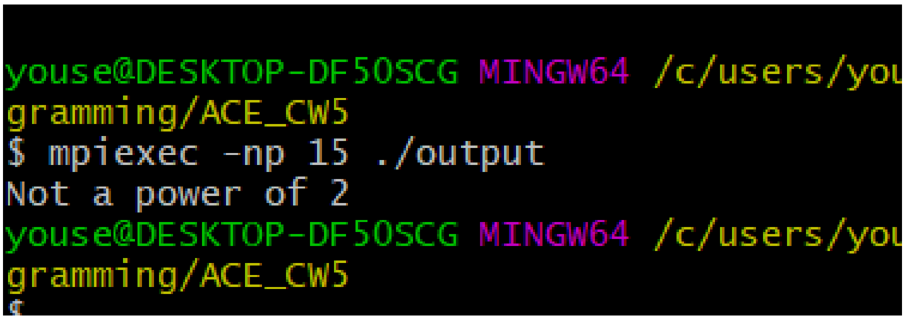


Figure 3: 5x10=50, 5x25=125

- **Number of processors assigned is not a power of 2.**



- **Number of Terms > Number of Processors**
  Automatically capped at number of processors.

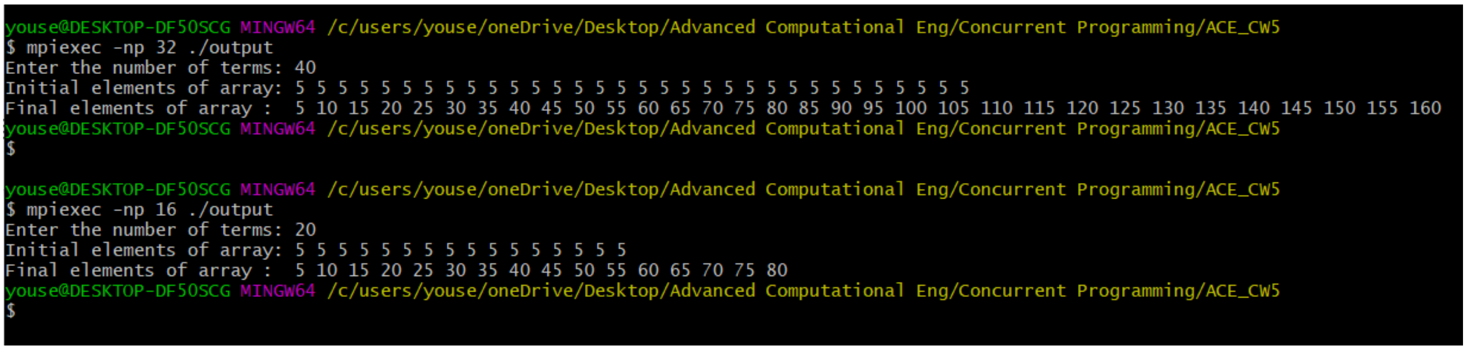


Figure 4: 5x32=160, 5x16=80

➢ Real operation

```
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpicc -o output prefix.c

youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 8 ./output
Enter the number of terms: 8
Initial elements of array: 3 0 2 4 7 4 4 2
Final elements of array :  3 3 5 9 16 20 24 26
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$

youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 16 ./output
Enter the number of terms: 16
Initial elements of array: 3 5 3 1 8 6 1 9 6 3 3 7 1 5 3 5
Final elements of array :  3 8 11 12 20 26 27 36 42 45 48 55 56 61 64 69
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$

youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 32 ./output
Enter the number of terms: 20
Initial elements of array: 1 3 4 1 6 4 6 2 9 6 7 2 6 0 7 7 2 1 9 1 0 0 0 0 0 0 0 0 0 0 0 0
Final elements of array :  1 4 8 9 15 19 25 27 36 42 49 51 57 57 64 71 73 74 83 84 84 84 84 84 84 84 84 84 84 84 84 84
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$
```

➢ Extended real operation

```
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 128 ./output
Enter the number of terms: 120
Initial elements of array: 8 0 5 2 9 1 1 4 6 5 4 0 8 4 1 4 1 2 5 8 0 4 2 5 2 2 1 9 3 5 0 2 6 2 8 8 1 9 4 0 9 3 8 6 5 5 7 1 2 3 9 5 8 8 9 3 8 0 6 2 1
5 6 7 8 0 9 5 6 5 3 8 3 3 7 8 6 1 8 7 9 8 0 1 9 7 7 6 3 4 9 6 3 9 5 7 8 1 3 1 8 5 7 1 6 4 1 1 7 9 9 9 7 4 7 4 8 0 9 8 0 0 0 0 0 0 0 0
Final elements of array :  8 8 13 15 24 25 26 30 36 41 45 45 53 57 58 62 63 65 70 78 78 82 84 89 91 93 94 103 106 111 111 113 119 121 129 137 138 147
 151 151 160 163 171 177 182 187 194 195 197 200 209 214 222 230 239 242 250 250 256 258 259 264 270 277 285 285 294 299 305 310 313 321 324 327 334
342 348 349 357 364 373 381 381 382 391 398 405 411 414 418 427 433 436 445 450 457 465 466 469 470 478 483 490 491 497 501 502 503 510 519 528 537 5
44 548 555 559 567 567 576 584 584 584 584 584 584 584 584 584
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$

youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$ mpiexec -np 256 ./output
Enter the number of terms: 256
Initial elements of array: 3 8 0 8 1 9 7 1 2 8 4 7 2 7 9 1 7 1 8 4 5 1 1 5 6 5 9 3 5 4 5 5 2 2 3 4 3 8 4 6 9 4 8 4 2 9 2 0 9 4 1 4 2 7 1 3 9 2 8 7 8
9 0 5 5 7 3 4 3 6 8 0 1 4 6 0 4 4 4 0 8 1 1 5 3 6 3 4 0 7 3 8 1 0 5 1 3 7 4 6 4 6 1 9 6 4 9 9 6 3 8 7 1 6 8 5 1 5 5 7 3 8 1 0 7 7 0 9 2 1 6 7 8 4 6 5
 0 7 9 4 5 3 4 7 5 3 4 2 0 8 2 3 9 9 6 8 1 5 2 8 0 3 0 1 9 4 9 9 9 4 8 3 3 4 3 0 0 0 2 5 7 6 8 4 0 0 6 8 0 9 7 4 0 8 5 8 4 1 9 5 1 8 2 0 1 0 4 7 4 9
0 4 6 0 3 6 5 9 7 4 1 9 9 9 1 9 9 7 4 6 3 5 3 4 9 9 0 7 1 9 2 1 1 7 4 8 9 6 8 2 1 3 1 3 8 8
Final elements of array :  3 11 11 19 20 29 36 37 39 47 51 58 60 67 76 77 84 85 93 97 102 103 104 109 115 120 129 132 137 141 146 151 153 155 158 162
 165 173 177 183 192 196 204 208 210 219 221 221 230 234 235 239 241 248 249 252 261 263 271 278 286 295 295 300 305 312 315 319 322 328 336 336 337
341 347 347 351 355 359 359 367 368 369 374 377 383 386 390 390 397 400 408 409 409 414 415 418 425 429 435 439 445 446 455 461 465 474 483 489 492 5
00 507 508 514 522 527 528 533 538 545 548 556 557 557 564 571 571 580 582 583 589 596 604 608 614 619 619 626 635 639 644 647 651 658 663 666 670 67
2 672 680 682 685 694 703 709 717 718 723 725 733 733 736 736 737 746 750 759 768 777 781 789 792 795 799 802 802 802 802 804 809 816 822 830 834 834
 834 840 848 848 857 864 868 868 876 881 889 893 894 903 908 909 917 919 919 920 920 924 931 935 944 944 948 954 954 957 963 968 977 984 988 989 998
1007 1016 1017 1026 1035 1042 1046 1052 1055 1060 1063 1067 1076 1085 1085 1092 1093 1102 1104 1105 1106 1113 1117 1125 1134 1140 1148 1150 1151 1154
 1155 1158 1166 1174
youse@DESKTOP-DF50SCG MINGW64 /c/users/youse/oneDrive/Desktop/Advanced Computational Eng/Concurrent Programming/ACE_CW5
$
```

➢ Conclusion

The design of this program allows it to be run in parallel across a number of separate computers connected in a network by enabling point to point communication between the CPUs. The code is designed in such a way, that each CPU takes a different route within it depending on the CPU's rank (or ID). This could achieve a considerable speed up if implemented on a large dataset, given that the parallel resources were available. This parallelisation is done by dividing large problems into smaller ones. These tasks are then sent to the available CPUs where they can be solved simultaneously and their results communicated back to the master CPU.