Министерство науки и высшего образования Российской Федерации

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Кафедра «Информационных технологий и систем»

Дисциплина «Организация взаимодействия процессов через pipe и FIFO в UNIX»

Отчет по лабораторной работе

«Семафоры в UNIX как средство синхронизации процессов»

Выполнил студент группы 9091

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**Цель лабораторной работы**

Цель работы: Познакомится с методами обмена информации между процессами в OS Linux;

**Исходный текст программ**

|  |
| --- |
| main.cpp |
| #include <stdio.h>  #include <sys/shm.h>  #include <stdlib.h>  #include <unistd.h>  #include <sys/types.h>  #include <sys/wait.h>  #include <sys/sem.h>  #include <sys/errno.h>  int \*allocateSharedMemory(size\_t memSize, int &ShMemId)  {  ShMemId = shmget(IPC\_PRIVATE, memSize, 0600|IPC\_CREAT|IPC\_EXCL);  if(ShMemId <= 0)  {  perror("Fatal error trying shmget()\n");  return NULL;  }  int \*memPtr = (int \*)shmat(ShMemId, 0, 0);  if(memPtr == NULL)  {  perror("Fatal error trying shmat()\n");  }  return memPtr;  }  void fillArrayRangedSem(int \*ShMemPtr, int ArraySize, int Max, int Min, struct sembuf \* Obj)  {  for(int i = 0; i < ArraySize; i++)  {  \*ShMemPtr = (rand() % (Max - Min + 1)) + Min;  printf("%i is %i\n", i+1, \*ShMemPtr);  Obj [i].sem\_op = 1;  Obj [i].sem\_flg = 0;  Obj [i].sem\_num = i;  ShMemPtr++;  };  printf("Filled array with %i pseudo-rand int\n", ArraySize);  }  void tryGetSemaphore(int SemID, int SemNum)  {  struct sembuf Lock;  Lock.sem\_op = -1;  Lock.sem\_flg = 0;  Lock.sem\_num = SemNum;  semop(SemID, &Lock, 1);  }  int tryGetSemaphoreNW(int SemID,int SemNum)  {  struct sembuf CheckSem;  CheckSem.sem\_op = 0;  CheckSem.sem\_flg = IPC\_NOWAIT;  CheckSem.sem\_num = SemNum;  return(semop(SemID, &CheckSem, 1));  }  void incSemaphore(int SemID, int SemNum)  {  struct sembuf Init;  Init.sem\_op = 1;  Init.sem\_flg = 0;  Init.sem\_num = SemNum;  semop(SemID, &Init, 1);  }  void sortArraySM(int \*mem, int ArraySize, int SemID)  {  int temp;  for (int i = 0; i < ArraySize - 1; i++)  {  for (int j = 0; j < ArraySize - i - 1; j++)  {  if (mem[j] > mem[j + 1])  {  tryGetSemaphore(SemID, j);  tryGetSemaphore(SemID, j+1);  temp = mem[j];  mem[j] = mem[j + 1];  mem[j + 1] = temp;  incSemaphore(SemID, j);  incSemaphore(SemID, j+1);  };  };  };  }  void printArray(int \*ShMemPointer, int ArraySize)  {  printf("Sorted Array\n");  for(int i = 0; i < ArraySize; i++)  {  printf("%i is %i\n", i+1, \*ShMemPointer);  ShMemPointer++;  };  }  int main (int argc, char \*argv[])  {  const size\_t memSize = 1024; //alias of PAGE\_SIZE  const short unsigned int ArraySize = atoi(argv[1]);  const short unsigned int ArrayMin = atoi(argv[2]);  const short unsigned int ArrayMax = atoi(argv[3]);  int ShMemId, SemID;  char pathname[] = "main.cpp";  key\_t key; //IPC Key  struct sembuf mySembuf[ArraySize];  if((key = ftok(pathname,0)) < 0)  {  printf("Cant generate key");  exit(-1);  };  if((SemID = semget(key,ArraySize, 0666 | IPC\_CREAT)) < 0 )  {  printf("Cant get semid");  exit(-1);  }  int \*ShMemPointer = allocateSharedMemory(memSize, ShMemId);  fillArrayRangedSem(ShMemPointer, ArraySize, ArrayMax, ArrayMin, mySembuf);  if(semop(SemID, mySembuf, ArraySize) < 0)  {  printf("Can't initialize SemArray\n");  printf ("err = %d\n", errno);  }  pid\_t childId = fork();  if(childId < 0)  {  perror("fork error");  }  else if(childId > 0)  {  int iCounter = 0;  while (!waitpid(childId, NULL, WNOHANG))  {  printf("Itteration numer: %i \n", iCounter+1);  for(int i = 0; i < ArraySize; i++)  {  if(tryGetSemaphoreNW(SemID,i) != 0)  {  //printf("%i is unlocked\n", i+1);  }  else  {  printf("%i is locked\n", i+1);  };  }  iCounter++;  }  }  else  {  sortArraySM(ShMemPointer, ArraySize, SemID);  exit(0);  };  printArray(ShMemPointer, ArraySize);  //Freeing system resources  if(shmctl(ShMemId,IPC\_RMID, 0) == 0)  {  printf("Shared memory cleared!\n");  }  else  {  perror("Shared memory control problem!\n");  };  if(semctl(SemID,0,IPC\_RMID,0) == 0)  {  printf("Semaphore array removed\n");  }  else  {  printf("Semaphore error!");  };  } |

**Результат выполнения программ**

|  |
| --- |
| g++ main.cpp -o main  ./main 50 1 30  1 is 14  2 is 17  3 is 28  4 is 26  5 is 24  6 is 26  7 is 17  8 is 13  9 is 10  10 is 2  11 is 3  12 is 8  13 is 21  14 is 20  15 is 24  16 is 17  17 is 1  18 is 7  19 is 23  20 is 17  21 is 12  22 is 9  23 is 28  24 is 10  25 is 3  26 is 21  27 is 3  28 is 14  29 is 8  30 is 26  31 is 30  32 is 13  33 is 13  34 is 19  35 is 30  36 is 28  37 is 14  38 is 17  39 is 2  40 is 23  41 is 10  42 is 4  43 is 22  44 is 30  45 is 15  46 is 8  47 is 9  48 is 15  49 is 6  50 is 1  Filled array with 50 pseudo-rand int  Itteration numer: 1  Itteration numer: 2  Itteration numer: 3  Itteration numer: 4  Itteration numer: 5  Itteration numer: 6  Itteration numer: 7  Itteration numer: 8  Itteration numer: 9  Itteration numer: 10  Itteration numer: 11  Itteration numer: 12  Itteration numer: 13  Itteration numer: 14  Itteration numer: 15  Itteration numer: 16  Itteration numer: 17  Itteration numer: 18  Itteration numer: 19  Itteration numer: 20  Itteration numer: 21  Itteration numer: 22  Itteration numer: 23  Itteration numer: 24  Itteration numer: 25  Itteration numer: 26  Itteration numer: 27  Itteration numer: 28  Itteration numer: 29  Itteration numer: 30  Itteration numer: 31  Itteration numer: 32  Itteration numer: 33  Itteration numer: 34  Itteration numer: 35  Itteration numer: 36  Itteration numer: 37  Itteration numer: 38  Itteration numer: 39  Itteration numer: 40  Itteration numer: 41  Itteration numer: 42  Itteration numer: 43  Itteration numer: 44  Itteration numer: 45  Itteration numer: 46  Itteration numer: 47  Itteration numer: 48  Itteration numer: 49  Itteration numer: 50  Itteration numer: 51  Itteration numer: 52  Itteration numer: 53  Itteration numer: 54  Itteration numer: 55  Itteration numer: 56  Itteration numer: 57  Itteration numer: 58  Itteration numer: 59  Itteration numer: 60  Itteration numer: 61  Itteration numer: 62  Itteration numer: 63  Itteration numer: 64  Itteration numer: 65  Itteration numer: 66  Itteration numer: 67  Itteration numer: 68  Itteration numer: 69  Itteration numer: 70  Itteration numer: 71  Itteration numer: 72  Itteration numer: 73  Itteration numer: 74  Itteration numer: 75  Itteration numer: 76  Itteration numer: 77  Itteration numer: 78  13 is locked  14 is locked  Itteration numer: 79  13 is locked  14 is locked  Itteration numer: 80  13 is locked  14 is locked  Itteration numer: 81  13 is locked  14 is locked  Itteration numer: 82  13 is locked  14 is locked  Itteration numer: 83  13 is locked  14 is locked  Itteration numer: 84  13 is locked  14 is locked  Itteration numer: 85  13 is locked  14 is locked  Itteration numer: 86  13 is locked  14 is locked  Itteration numer: 87  13 is locked  14 is locked  Itteration numer: 88  13 is locked  14 is locked  Itteration numer: 89  13 is locked  14 is locked  Itteration numer: 90  13 is locked  14 is locked  Itteration numer: 91  13 is locked  14 is locked  Itteration numer: 92  13 is locked  14 is locked  Itteration numer: 93  13 is locked  14 is locked  Itteration numer: 94  13 is locked  14 is locked  Itteration numer: 95  13 is locked  14 is locked  Itteration numer: 96  13 is locked  14 is locked  Itteration numer: 97  13 is locked  14 is locked  Itteration numer: 98  13 is locked  14 is locked  Itteration numer: 99  13 is locked  14 is locked  Itteration numer: 100  13 is locked  14 is locked  Itteration numer: 101  13 is locked  14 is locked  Itteration numer: 102  13 is locked  14 is locked  Itteration numer: 103  13 is locked  14 is locked  Itteration numer: 104  13 is locked  14 is locked  Itteration numer: 105  12 is locked  13 is locked  Itteration numer: 106  12 is locked  13 is locked  Itteration numer: 107  12 is locked  13 is locked  Itteration numer: 108  12 is locked  13 is locked  Itteration numer: 109  12 is locked  13 is locked  Itteration numer: 110  12 is locked  13 is locked  Itteration numer: 111  12 is locked  13 is locked  Itteration numer: 112  12 is locked  13 is locked  Itteration numer: 113  12 is locked  13 is locked  Itteration numer: 114  12 is locked  13 is locked  Itteration numer: 115  12 is locked  13 is locked  Itteration numer: 116  12 is locked  13 is locked  Itteration numer: 117  12 is locked  13 is locked  Itteration numer: 118  12 is locked  13 is locked  Itteration numer: 119  12 is locked  13 is locked  Itteration numer: 120  12 is locked  13 is locked  Itteration numer: 121  12 is locked  13 is locked  Itteration numer: 122  12 is locked  13 is locked  Itteration numer: 123  12 is locked  13 is locked  Itteration numer: 124  12 is locked  13 is locked  Itteration numer: 125  12 is locked  13 is locked  Itteration numer: 126  12 is locked  13 is locked  Itteration numer: 127  12 is locked  13 is locked  Itteration numer: 128  12 is locked  13 is locked  Itteration numer: 129  12 is locked  13 is locked  Itteration numer: 130  12 is locked  13 is locked  Itteration numer: 131  12 is locked  13 is locked  Itteration numer: 132  12 is locked  13 is locked  Itteration numer: 133  12 is locked  13 is locked  Itteration numer: 134  12 is locked  13 is locked  Itteration numer: 135  12 is locked  13 is locked  Itteration numer: 136  12 is locked  13 is locked  Itteration numer: 137  12 is locked  13 is locked  Itteration numer: 138  12 is locked  13 is locked  Itteration numer: 139  12 is locked  13 is locked  Itteration numer: 140  12 is locked  13 is locked  Itteration numer: 141  12 is locked  13 is locked  Itteration numer: 142  12 is locked  13 is locked  Itteration numer: 143  12 is locked  13 is locked  Itteration numer: 144  12 is locked  13 is locked  Itteration numer: 145  12 is locked  13 is locked  Itteration numer: 146  12 is locked  13 is locked  Itteration numer: 147  12 is locked  13 is locked  Itteration numer: 148  12 is locked  13 is locked  Itteration numer: 149  12 is locked  13 is locked  Itteration numer: 150  12 is locked  13 is locked  Itteration numer: 151  12 is locked  13 is locked  Itteration numer: 152  12 is locked  13 is locked  Itteration numer: 153  12 is locked  13 is locked  Itteration numer: 154  12 is locked  13 is locked  Itteration numer: 155  12 is locked  13 is locked  Itteration numer: 156  12 is locked  13 is locked  Itteration numer: 157  12 is locked  13 is locked  Itteration numer: 158  12 is locked  13 is locked  Itteration numer: 159  12 is locked  13 is locked  Itteration numer: 160  12 is locked  13 is locked  Itteration numer: 161  12 is locked  13 is locked  Itteration numer: 162  12 is locked  13 is locked  Itteration numer: 163  12 is locked  13 is locked  Itteration numer: 164  12 is locked  13 is locked  Itteration numer: 165  12 is locked  13 is locked  Itteration numer: 166  12 is locked  13 is locked  Itteration numer: 167  12 is locked  13 is locked  Itteration numer: 168  12 is locked  13 is locked  Itteration numer: 169  12 is locked  13 is locked  Itteration numer: 170  12 is locked  13 is locked  Itteration numer: 171  12 is locked  13 is locked  Itteration numer: 172  12 is locked  13 is locked  Itteration numer: 173  12 is locked  13 is locked  Itteration numer: 174  12 is locked  13 is locked  Itteration numer: 175  12 is locked  13 is locked  Itteration numer: 176  12 is locked  13 is locked  Itteration numer: 177  12 is locked  13 is locked  Itteration numer: 178  12 is locked  13 is locked  Itteration numer: 179  12 is locked  13 is locked  Itteration numer: 180  12 is locked  13 is locked  Itteration numer: 181  12 is locked  13 is locked  Itteration numer: 182  12 is locked  13 is locked  Itteration numer: 183  12 is locked  13 is locked  Itteration numer: 184  12 is locked  13 is locked  Itteration numer: 185  12 is locked  13 is locked  Itteration numer: 186  12 is locked  13 is locked  Itteration numer: 187  12 is locked  13 is locked  Itteration numer: 188  12 is locked  13 is locked  Itteration numer: 189  12 is locked  13 is locked  Itteration numer: 190  12 is locked  13 is locked  Itteration numer: 191  12 is locked  13 is locked  Itteration numer: 192  12 is locked  13 is locked  Itteration numer: 193  12 is locked  13 is locked  Itteration numer: 194  12 is locked  13 is locked  Itteration numer: 195  12 is locked  13 is locked  Itteration numer: 196  12 is locked  13 is locked  Itteration numer: 197  12 is locked  13 is locked  Itteration numer: 198  12 is locked  13 is locked  Itteration numer: 199  12 is locked  13 is locked  Itteration numer: 200  12 is locked  13 is locked  Itteration numer: 201  12 is locked  13 1 is 14 is locked  Itteration numer: 202  12 is locked  13 is locked  Itteration numer: 203  12 is locked  13 is locked  Itteration numer: 204  12 is locked  13 is locked  Itteration numer: 205  12 is locked  13 is locked  Itteration numer: 206  12 is locked  13 is locked  Itteration numer: 207  12 is locked  13 is locked  Itteration numer: 208  12 is locked  13 is locked  Itteration numer: 209  12 is locked  13 is locked  Itteration numer: 210  12 is locked  13 is locked  Itteration numer: 211  12 is locked  13 is locked  Itteration numer: 212  12 is locked  13 is locked  Itteration numer: 213  12 is locked  13 is locked  Sorted Array  1 is 1  2 is 1  3 is 2  4 is 2  5 is 3  6 is 3  7 is 3  8 is 4  9 is 6  10 is 7  11 is 8  12 is 8  13 is 8  14 is 9  15 is 9  16 is 10  17 is 10  18 is 10  19 is 12  20 is 13  21 is 13  22 is 13  23 is 14  24 is 14  25 is 14  26 is 15  27 is 15  28 is 17  29 is 17  30 is 17  31 is 17  32 is 17  33 is 19  34 is 20  35 is 21  36 is 21  37 is 22  38 is 23  39 is 23  40 is 24  41 is 24  42 is 26  43 is 26  44 is 26  45 is 28  46 is 28  47 is 28  48 is 30  49 is 30  50 is 30  Shared memory cleared!  Semaphore array removed |
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**Вывод**

Вывод: выполняя лабораторную работу, я научился работать с методами синхронизации процессов с помощью семафоров.