Environment

- When a program is executed...
  - process that does exec can pass command-line arguments to the new program
  - this is part of the UNIX system shells

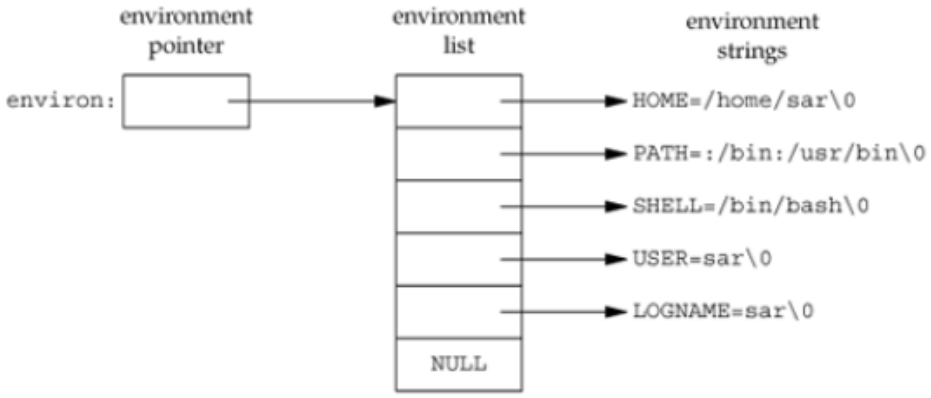
```
int main( int argc, char *argv[] )
{
    int  i;

        /* echo all command-line args */
    for ( i = 0 ; i < argc ;  i++ )
        printf( "argv[%d]: %s\n", i, argv[i] );
}
```


Environment

- Environment List
  - each program also passed an environment list
  - this list is an array of char pointers, with each pointer containing the address of a null-terminated C string
  - the address of the array of pointers is contained in the global variable *environ*:
  - extern char **environ;

Environment

- Example of environment with five strings
  - the null bytes a tthe end of each string are explicitly shown



Environment

- Terms
  - *environ* is called the *environment pointer*
  - the array of pointers is called the *environment list*
  - the strings they point to are called *environment strings*

Environment

- Historically, most UNIX systems have provided a third argument to the main function that is the address to the environment list
  - *int main(int argc, char *argv[], char *envp[])*;
  - Because ISO C specifies that the main function be written with two arguments, and because this third argument provides no benefit over the global variable *environ*, POSIX.1 specifies that *environ* should be used instead of the (possible) third argument. Access to specific environment variables is normally through the *getenv* and *putenv* functions instead of through the *environ* variable. But to go through the entire environment, the environ pointer must be used.

Environment

- Show the environment

```
#include <stdio.h>

int main( int argc, char *argv[], char *envp[] )
{
    int  i;
         /* echo all environment args */
    for (i = 0 ; envp[i] ;  i++)
        printf( "envp[%d]: %s\n", i, envp[i] );
}
```

Environment

- Environment Variables
  - environment strings are usually of the form *name=value*
  - the Unix kernel never looks at these strings
  - their interpretation is up the the various applications
  - the shell uses numerous environment variables
    - some are automatically set at login, e.g., *HOME*, *USER*
    - others are for us to set, e.g., If we set the environment variable MAILPATH, for example, it tells the Bourne shell, GNU Bourne-again shell, and Korn shell where to look for mail.

Environment

- Support for various environment list functions

Function	ISO C	POSIX.1	FreeBSD 5.2.1	Linux 2.4.22	Mac OS X 10.3	Solaris 9
getenv	•	•	•	•	•	•
putenv		XSI	•	•	•	•
setenv		•	•	•	•	
unsetenv		•	•	•	•	
clearenv				•		

Environment

ISO C defines a function that we can use to fetch values from the environment, but this standard says that the contents of the environment are implementation defined.

```
#include <stdlib.h>

char *getenv(const char *name);
```

Returns: pointer to value associated with name, NULL if not found

Note that this function returns a pointer to the value of a *name=value* string. We should always use `getenv` to fetch a specific value from the environment, instead of accessing `environ` directly.

Environment

- Manipulating environment variables

```
#include <stdlib.h>

int putenv(char *str);
int setenv(const char *name, const char *value, int rewrite);
int unsetenv(const char *name);
```

All return: 0 if OK, nonzero on error

The `putenv` function takes a string of the form *name=value* and places it in the environment list. If *name* already exists, its old definition is first removed.

Environment

- Manipulating environment variables

```
#include <stdlib.h>

int putenv(char *str);
int setenv(const char *name, const char *value, int rewrite);
int unsetenv(const char *name);
```

All return: 0 if OK, nonzero on error

The `setenv` function sets *name* to *value*. If *name* already exists in the environment, then (a) if *rewrite* is nonzero, the existing definition for name is first removed; (b) if *rewrite* is 0, an existing definition for *name* is not removed, *name* is not set to the new value, and no error occurs.

Environment

- Manipulating environment variables

```
#include <stdlib.h>

int putenv(char *str);
int setenv(const char *name, const char *value, int rewrite);
int unsetenv(const char *name);
```

All return: 0 if OK, nonzero on error

The `unsetenv` function removes any definition of *name*. It is not an error if such a definition does not exist.

Environment

- Manipulating environment variables

```
#include <stdlib.h>

int putenv(char *str);
int setenv(const char *name, const char *value, int rewrite);
int unsetenv(const char *name);
```

All return: 0 if OK, nonzero on error

Note the difference between `putenv` and `setenv`. Whereas `setenv` must allocate memory to create the *name=value* string from its arguments, `putenv` is free to place the string passed to it directly into the environment. On Linux and Solaris, the `putenv` implementation places the address of the string we pass to it directly into the environment list. In this case, it would be an error to pass it a string allocated on the stack, since the memory would be reused after we return from the current function.