Variables and other tricks in Bash

ComS 252 — Iowa State University

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Warning

- The syntax for this lecture is specific to `bash`
- Other shells may support some of these things
  - Sometimes using the same syntax
  - Sometimes using a different syntax

Defining

To define a variable in bash:

```
VARNAME=value
```

Note:

- Variables have no type
  - Or, if you prefer, they all have type string
- Variable names must start with a letter or underscore
- Variable names may contain digits
- Variable names are case sensitive

Using

To use a variable in `bash`:

```
$VARNAME
```

Note:

- If the variable has not been defined, you get empty string

Using

To use a variable in `bash`:

```
$VARNAME
```

Note:

- If the variable has not been defined, you get empty string

You can also use *substrings* of variables in `bash`:

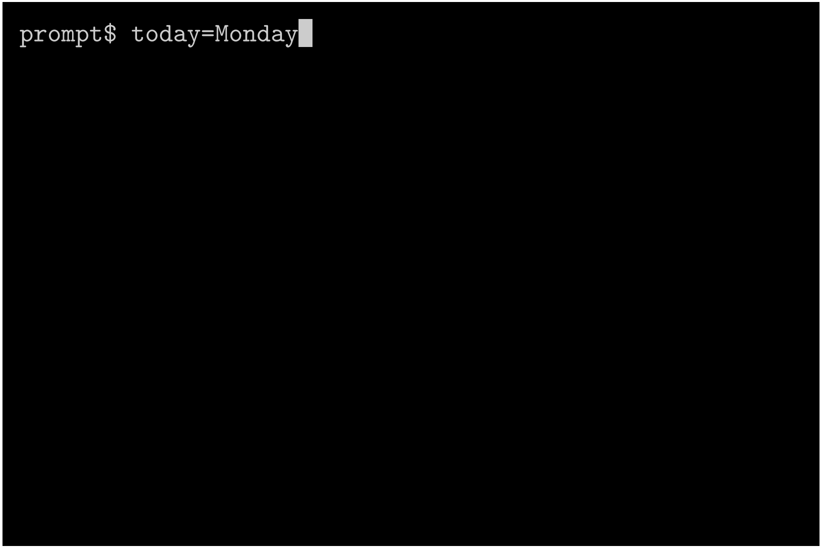
${VARNAME:n}
: *Use variable VARNAME but discard the first n characters*

${VARNAME:n:m}
: *Use variable VARNAME but discard the first n characters, and use only the first m characters after that*

Simple example for variables

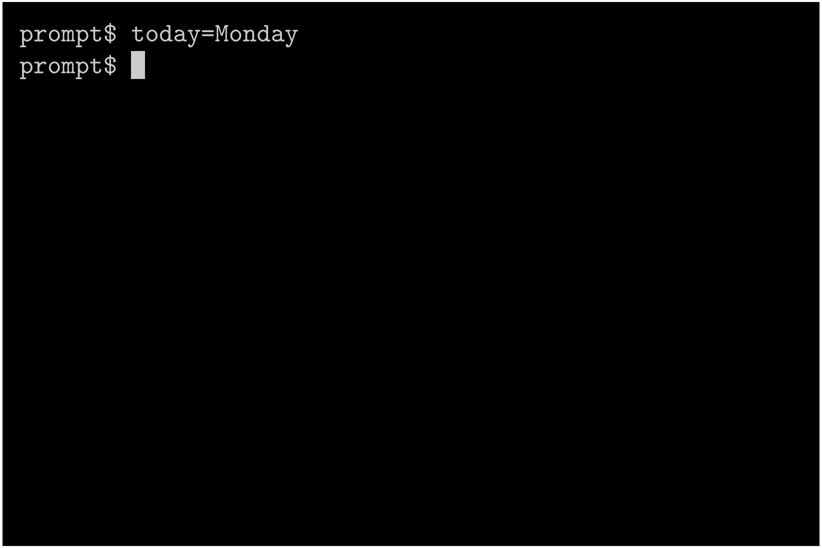
```
prompt$ 
```

Simple example for variables



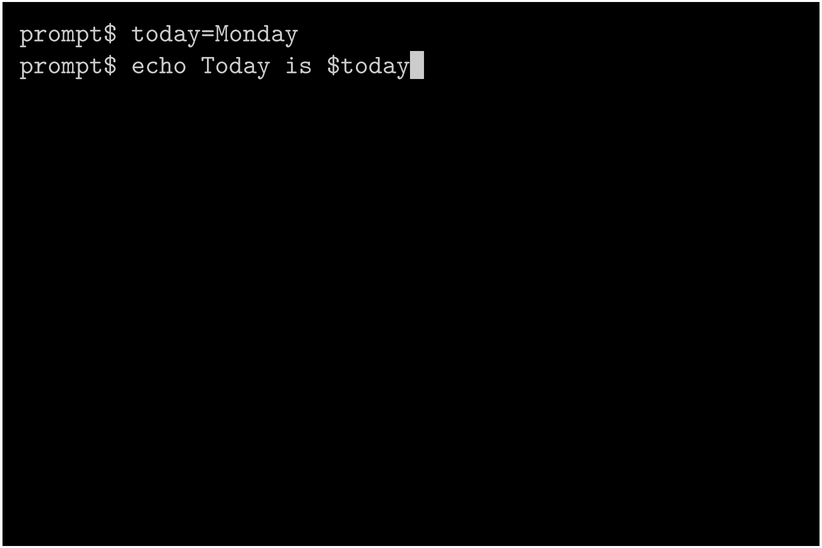
```
prompt$ today=Monday
```

Simple example for variables



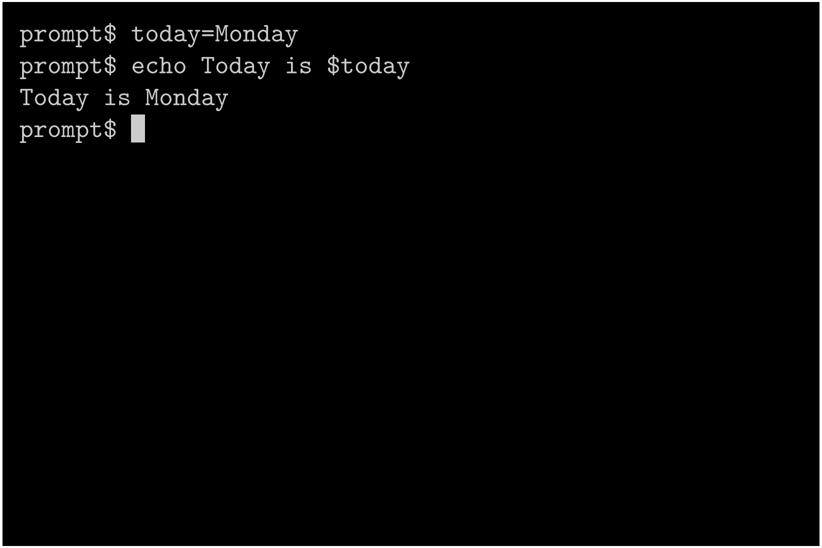
```
prompt$ today=Monday
prompt$ 
```

Simple example for variables



```
prompt$ today=Monday
prompt$ echo Today is $today
```

Simple example for variables



```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ 
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ █
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
Tomorrow is
prompt$ █
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
Tomorrow is
prompt$ tomorrow=$today
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
Tomorrow is
prompt$ tomorrow=$today
prompt$ █
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
Tomorrow is
prompt$ tomorrow=$today
prompt$ today=Monday
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
Tomorrow is
prompt$ tomorrow=$today
prompt$ today=Monday
prompt$ █
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
Tomorrow is
prompt$ tomorrow=$today
prompt$ today=Monday
prompt$ !e
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
Tomorrow is
prompt$ tomorrow=$today
prompt$ today=Monday
prompt$ !e
echo Tomorrow is $tomorrow
Tomorrow is Tuesday
prompt$ █
```

Simple example for variables

```
prompt$ today=Monday
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
Tomorrow is
prompt$ tomorrow=$today
prompt$ today=Monday
prompt$ !e
echo Tomorrow is $tomorrow
Tomorrow is Tuesday
prompt$ echo Tomorrow shorthand is ${tomorrow:0:3}█
```

Simple example for variables

```
prompt$ echo Today is $today
Today is Monday
prompt$ today=Tuesday
prompt$ !e
echo Today is $today
Today is Tuesday
prompt$ echo Tomorrow is $tomorrow
Tomorrow is
prompt$ tomorrow=$today
prompt$ today=Monday
prompt$ !e
echo Tomorrow is $tomorrow
Tomorrow is Tuesday
prompt$ echo Tomorrow shorthand is ${tomorrow:0:3}
Tomorrow shorthand is Tue
prompt$ █
```

Reading values from standard input

`read`: read values into variables

- Usage: `read var1 var2 ...var`*n*
  - Reads a line from standard input
  - The first word goes into `var1`
  - The second word (if any) goes into `var2`

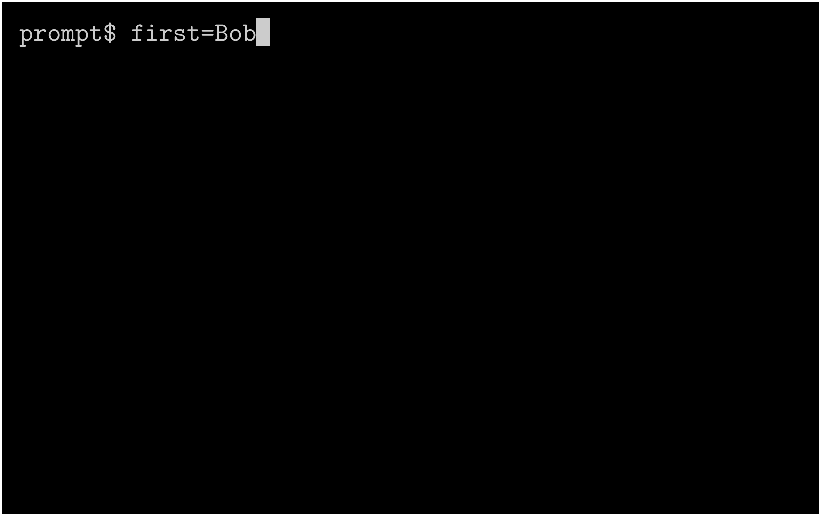
    ⋮
  - Any remaining words go into `var`*n*
- Variables `var1`, ..., `var`*n* can be existing or not

`-p` : Specify a prompt

read examples

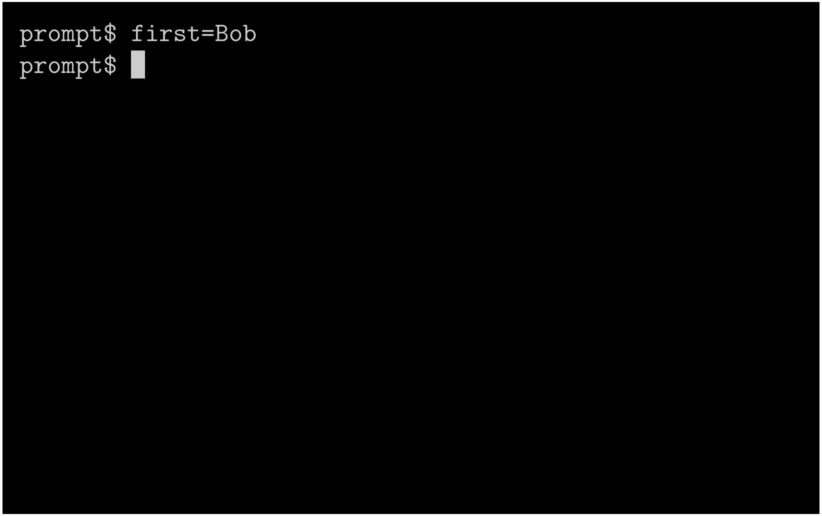
```
prompt$ 
```

read examples



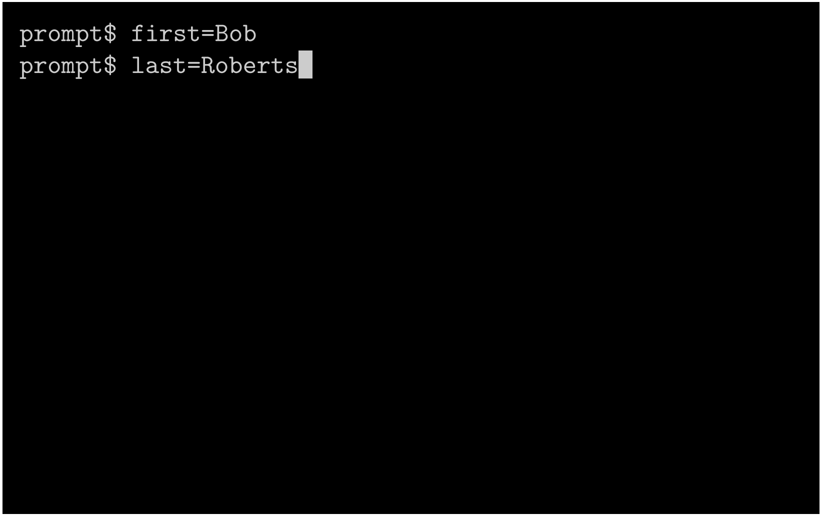
```
prompt$ first=Bob
```

read examples



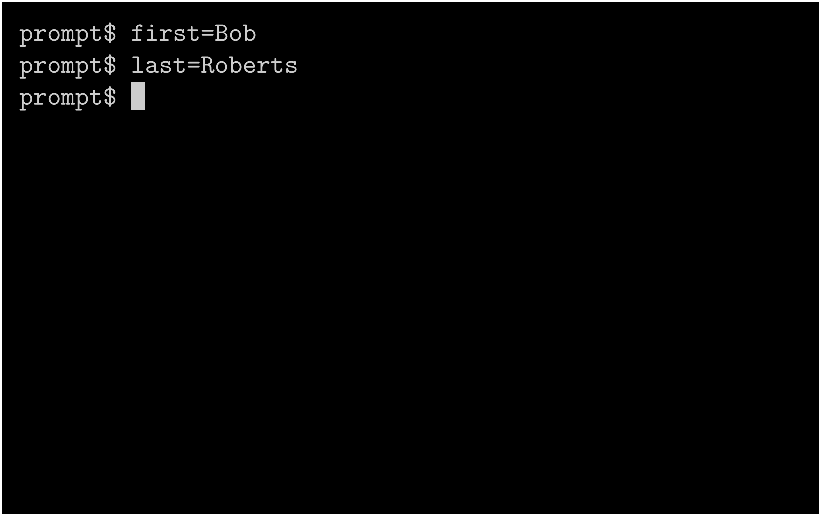
```
prompt$ first=Bob
prompt$ █
```

read examples



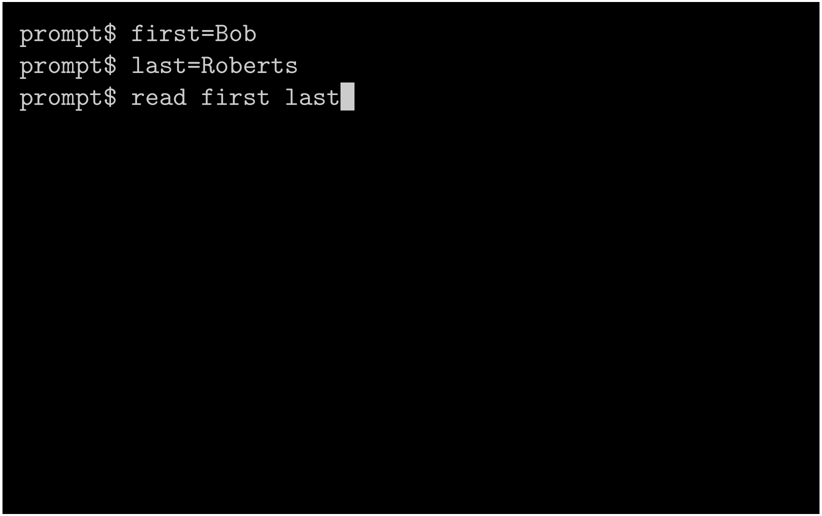
```
prompt$ first=Bob
prompt$ last=Roberts
```

read examples



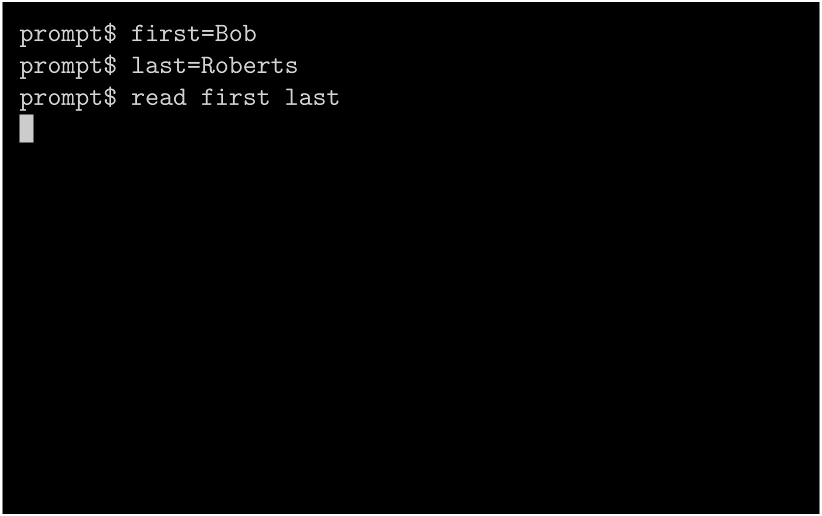
```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ 
```

read examples



```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
```

read examples



```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
█
```

read examples

```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
```

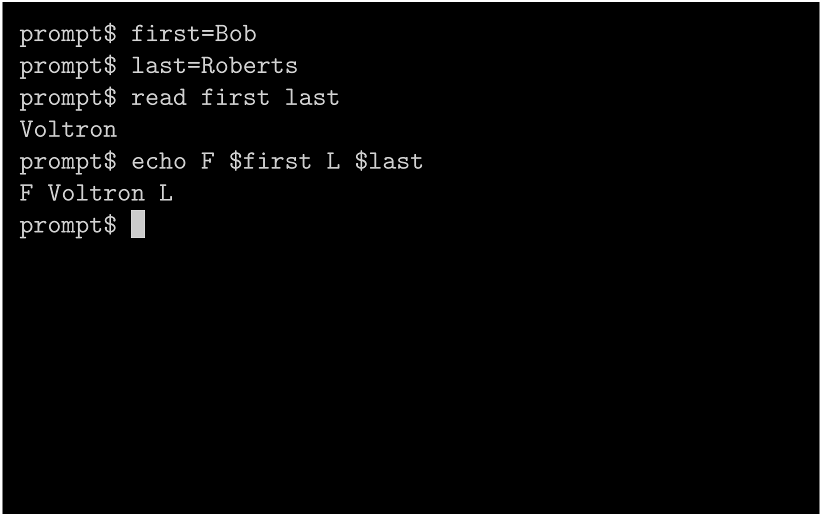
read examples

```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
prompt$ █
```

read examples

```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
prompt$ echo F $first L $last
```

read examples



```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
prompt$ echo F $first L $last
F Voltron L
prompt$ 
```

read examples

```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
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prompt$ echo F $first L $last
F Voltron L
prompt$ read first last
```

read examples

```
prompt$ first=Bob
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prompt$ read first last
Voltron
prompt$ echo F $first L $last
F Voltron L
prompt$ read first last
█
```
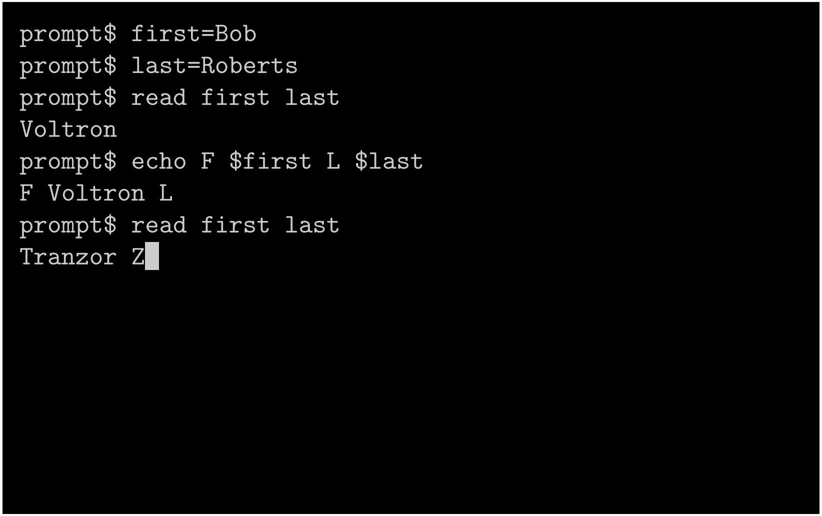

read examples



```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
prompt$ echo F $first L $last
F Voltron L
prompt$ read first last
Tranzor Z
```

read examples

```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
prompt$ echo F $first L $last
F Voltron L
prompt$ read first last
Tranzor Z
prompt$ █
```

read examples

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prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
prompt$ echo F $first L $last
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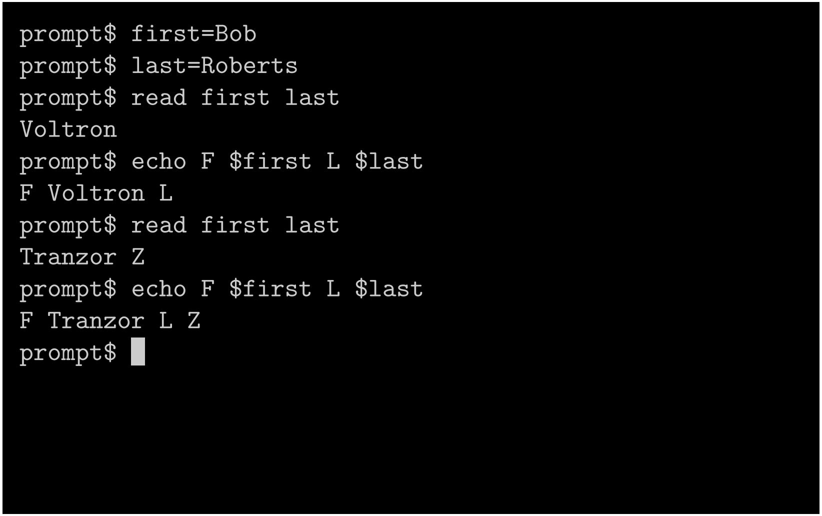
prompt$ read first last
Tranzor Z
prompt$ echo F $first L $last
```

read examples



```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
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prompt$ echo F $first L $last
F Voltron L
prompt$ read first last
Tranzor Z
prompt$ echo F $first L $last
F Tranzor L Z
prompt$ 
```

read examples

```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
prompt$ echo F $first L $last
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Tranzor Z
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F Tranzor L Z
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```

read examples

```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
prompt$ echo F $first L $last
F Voltron L
prompt$ read first last
Tranzor Z
prompt$ echo F $first L $last
F Tranzor L Z
prompt$ read first last
█
```

read examples

```
prompt$ first=Bob
prompt$ last=Roberts
prompt$ read first last
Voltron
prompt$ echo F $first L $last
F Voltron L
prompt$ read first last
Tranzor Z
prompt$ echo F $first L $last
F Tranzor L Z
prompt$ read first last
The artist formerly known as Prince
```

read examples

```
prompt$ first=Bob
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prompt$ read first last
Voltron
prompt$ echo F $first L $last
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F Tranzor L Z
prompt$ read first last
The artist formerly known as Prince
prompt$ █
```

read examples

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prompt$ first=Bob
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F Tranzor L Z
prompt$ read first last
The artist formerly known as Prince
prompt$ echo F $first L $last
```

read examples

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prompt$ first=Bob
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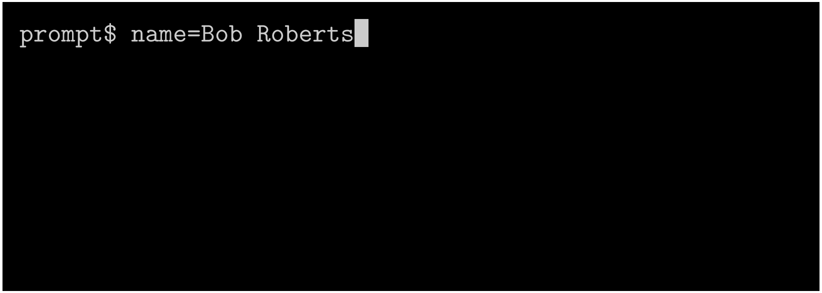
prompt$ read first last
Voltron
prompt$ echo F $first L $last
F Voltron L
prompt$ read first last
Tranzor Z
prompt$ echo F $first L $last
F Tranzor L Z
prompt$ read first last
The artist formerly known as Prince
prompt$ echo F $first L $last
F The L artist formerly known as Prince
prompt$ █
```

Motivating variable examples

```
prompt$ █
```

Motivating variable examples



```
prompt$ name=Bob Roberts
```

Motivating variable examples

```
prompt$ name=Bob Roberts
-bash: Roberts: command not found
prompt$ █
```

Questions:

1. Can a variable be set to a string with spaces?

Motivating variable examples

```
prompt$ name=Bob Roberts
-bash: Roberts: command not found
prompt$ dir=ls
```

Questions:

1. Can a variable be set to a string with spaces?

Motivating variable examples

```
prompt$ name=Bob Roberts
-bash: Roberts: command not found
prompt$ dir=ls
prompt$ █
```

Questions:

1. Can a variable be set to a string with spaces?

Motivating variable examples

```
prompt$ name=Bob Roberts
-bash: Roberts: command not found
prompt$ dir=ls
prompt$ $dir
```

Questions:

1. Can a variable be set to a string with spaces?

Motivating variable examples

```
prompt$ name=Bob Roberts
-bash: Roberts: command not found
prompt$ dir=ls
prompt$ $dir
bar.txt   foo.txt   hello.c   Readme
prompt$ 
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type “`dir`” instead of “`$dir`”?

Motivating variable examples

```
prompt$ name=Bob Roberts
-bash: Roberts: command not found
prompt$ dir=ls
prompt$ $dir
bar.txt   foo.txt   hello.c   Readme
prompt$ bash
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type “`dir`” instead of “`$dir`”?

Motivating variable examples

```
prompt$ name=Bob Roberts
-bash: Roberts: command not found
prompt$ dir=ls
prompt$ $dir
bar.txt   foo.txt   hello.c   Readme
prompt$ bash
prompt$ █
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type "`dir`" instead of "`$dir`"?

Motivating variable examples

```
prompt$ name=Bob Roberts
-bash: Roberts: command not found
prompt$ dir=ls
prompt$ $dir
bar.txt   foo.txt   hello.c   Readme
prompt$ bash
prompt$ echo $dir
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type “`dir`” instead of “`$dir`”?

Motivating variable examples

```
-bash: Roberts: command not found
prompt$ dir=ls
prompt$ $dir
bar.txt   foo.txt   hello.c   Readme
prompt$ bash
prompt$ echo $dir

prompt$ █
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type "`dir`" instead of "`$dir`"?
3. Can I make variables visible to child processes?
4. Can I make variables visible to all shells?

Motivating variable examples

```
-bash: Roberts: command not found
prompt$ dir=ls
prompt$ $dir
bar.txt   foo.txt   hello.c   Readme
prompt$ bash
prompt$ echo $dir

prompt$ exit
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type "`dir`" instead of "`$dir`"?
3. Can I make variables visible to child processes?
4. Can I make variables visible to all shells?

Motivating variable examples

```
prompt$ dir=ls
prompt$ $dir
bar.txt    foo.txt    hello.c    Readme
prompt$ bash
prompt$ echo $dir

prompt$ exit
prompt$ █
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type "`dir`" instead of "`$dir`"?
3. Can I make variables visible to child processes?
4. Can I make variables visible to all shells?

Motivating variable examples

```
prompt$ dir=ls
prompt$ $dir
bar.txt   foo.txt   hello.c   Readme
prompt$ bash
prompt$ echo $dir

prompt$ exit
prompt$ i=3
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type "`dir`" instead of "`$dir`"?
3. Can I make variables visible to child processes?
4. Can I make variables visible to all shells?

Motivating variable examples

```
prompt$ $dir
bar.txt   foo.txt   hello.c   Readme
prompt$ bash
prompt$ echo $dir

prompt$ exit
prompt$ i=3
prompt$ █
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type "`dir`" instead of "`$dir`"?
3. Can I make variables visible to child processes?
4. Can I make variables visible to all shells?

Motivating variable examples

```
prompt$ $dir
bar.txt   foo.txt   hello.c   Readme
prompt$ bash
prompt$ echo $dir

prompt$ exit
prompt$ i=3
prompt$ echo $i+1
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type "`dir`" instead of "`$dir`"?
3. Can I make variables visible to child processes?
4. Can I make variables visible to all shells?

Motivating variable examples

```
prompt$ bash
prompt$ echo $dir

prompt$ exit
prompt$ i=3
prompt$ echo $i+1
3+1
prompt$ █
```

Questions:

1. Can a variable be set to a string with spaces?
2. Can I do something so I can type "`dir`" instead of "`$dir`"?
3. Can I make variables visible to child processes?
4. Can I make variables visible to all shells?
5. Can I do arithmetic in `bash`?

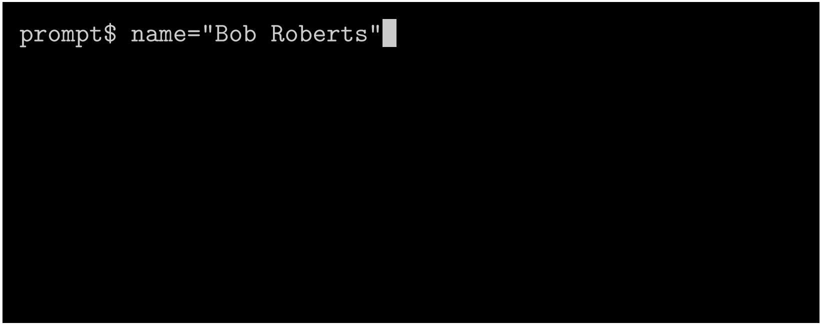
Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
prompt$ █
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution



```
prompt$ name="Bob Roberts"
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
prompt$ name="Bob Roberts"
prompt$ 
```

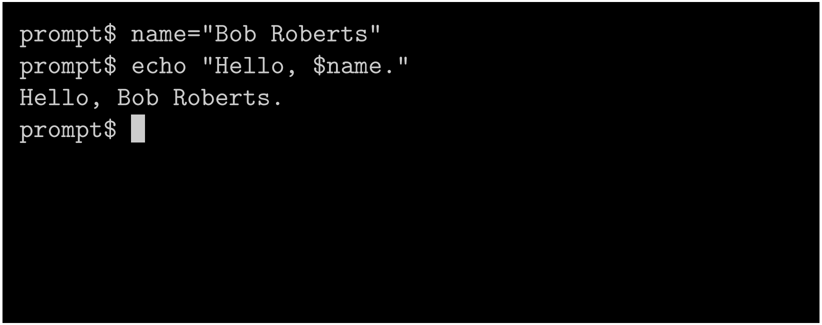
Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
prompt$ name="Bob Roberts"
prompt$ echo "Hello, $name."
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution



```
prompt$ name="Bob Roberts"
prompt$ echo "Hello, $name."
Hello, Bob Roberts.
prompt$ 
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
prompt$ name="Bob Roberts"
prompt$ echo "Hello, $name."
Hello, Bob Roberts.
prompt$ ls
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
prompt$ name="Bob Roberts"
prompt$ echo "Hello, $name."
Hello, Bob Roberts.
prompt$ ls
bar.txt   foo.txt   hello.c   Readme
prompt$ █
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
prompt$ name="Bob Roberts"
prompt$ echo "Hello, $name."
Hello, Bob Roberts.
prompt$ ls
bar.txt   foo.txt   hello.c   Readme
prompt$ echo "!!"
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
prompt$ name="Bob Roberts"
prompt$ echo "Hello, $name."
Hello, Bob Roberts.
prompt$ ls
bar.txt   foo.txt   hello.c   Readme
prompt$ echo "!!"
echo "ls"
ls
prompt$ █
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
prompt$ name="Bob Roberts"
prompt$ echo "Hello, $name."
Hello, Bob Roberts.
prompt$ ls
bar.txt   foo.txt   hello.c   Readme
prompt$ echo "!!"
echo "ls"
ls
prompt$ echo 2 * 3
```

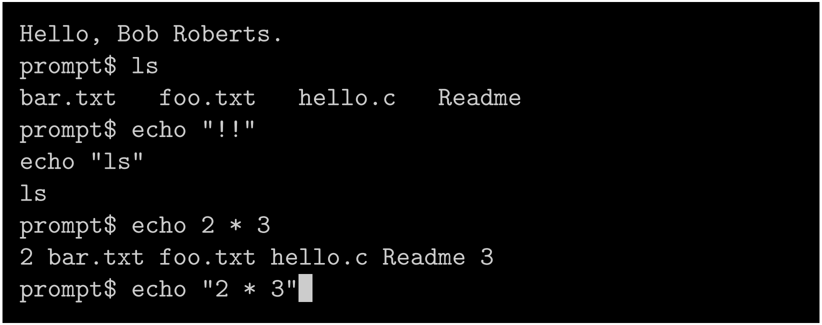
Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
Hello, Bob Roberts.
prompt$ ls
bar.txt   foo.txt   hello.c   Readme
prompt$ echo "!!"
echo "ls"
ls
prompt$ echo 2 * 3
2 bar.txt foo.txt hello.c Readme 3
prompt$ █
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution



```
Hello, Bob Roberts.
prompt$ ls
bar.txt   foo.txt   hello.c   Readme
prompt$ echo "!!"
echo "ls"
ls
prompt$ echo 2 * 3
2 bar.txt foo.txt hello.c Readme 3
prompt$ echo "2 * 3"
```

Double quotes

- Can group things into a single string
- Will prevent *some* shell expansions
- Still allows variable substitution

```
bar.txt   foo.txt   hello.c   Readme
prompt$ echo "!!"
echo "ls"
ls
prompt$ echo 2 * 3
2 bar.txt foo.txt hello.c Readme 3
prompt$ echo "2 * 3"
2 * 3
prompt$ 
```

Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ █
```

[1] If you find one that is not prevented, let me know!

Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ name='Bob Roberts'
```

[1] If you find one that is not prevented, let me know!

Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ name='Bob Roberts'
prompt$ █
```

[1]If you find one that is not prevented, let me know!

Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ name='Bob Roberts'
prompt$ echo $name
```

[1]If you find one that is not prevented, let me know!

Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ name='Bob Roberts'
prompt$ echo $name
Bob Roberts
prompt$ █
```

[1] If you find one that is not prevented, let me know!

Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ name='Bob Roberts'
prompt$ echo $name
Bob Roberts
prompt$ echo 'Hello, $name.'
```

[1] If you find one that is not prevented, let me know!

Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ name='Bob Roberts'
prompt$ echo $name
Bob Roberts
prompt$ echo 'Hello, $name.'
Hello, $name.
prompt$ █
```

[1]If you find one that is not prevented, let me know!

Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ name='Bob Roberts'
prompt$ echo $name
Bob Roberts
prompt$ echo 'Hello, $name.'
Hello, $name.
prompt$ echo '!!'
```

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Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ name='Bob Roberts'
prompt$ echo $name
Bob Roberts
prompt$ echo 'Hello, $name.'
Hello, $name.
prompt$ echo '!!'
!!
prompt$ █
```

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Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ name=’Bob Roberts’
prompt$ echo $name
Bob Roberts
prompt$ echo ’Hello, $name.’
Hello, $name.
prompt$ echo ’!!’
!!
prompt$ echo ’2 * 3’
```

[1] If you find one that is not prevented, let me know!

Single quotes

- Can group things into a single string
- Will prevent *all* shell expansions[1]
- Does not substitute variables

```
prompt$ echo $name
Bob Roberts
prompt$ echo ’Hello, $name.’
Hello, $name.
prompt$ echo ’!!’
!!
prompt$ echo ’2 * 3’
2 * 3
prompt$ █
```

[1] If you find one that is not prevented, let me know!

“Backward” quotes

- Are completely different from single and double quotes
- Use the accent character (usually, on your tilde key)
- Usage:

```
`command`
```

- Replaces the string with the output of the command
  - Whatever would have been written to standard output

```
prompt$
```

“Backward” quotes

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- Usage:

```
‘command‘
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  - Whatever would have been written to standard output

```
prompt$ today=‘date | head -c 10‘
```

“Backward” quotes

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- Use the accent character (usually, on your tilde key)
- Usage:

```
‘command‘
```

- Replaces the string with the output of the command
  - Whatever would have been written to standard output

```
prompt$ today=‘date | head -c 10‘
prompt$
```

"Backward" quotes

- Are completely different from single and double quotes
- Use the accent character (usually, on your tilde key)
- Usage:

```
`command`
```

- Replaces the string with the output of the command
  - Whatever would have been written to standard output

```
prompt$ today=`date | head -c 10`
prompt$ echo $today
```

“Backward” quotes

- Are completely different from single and double quotes
- Use the accent character (usually, on your tilde key)
- Usage:

```
‘command‘
```

- Replaces the string with the output of the command
  - Whatever would have been written to standard output

```
prompt$ today=‘date | head -c 10‘
prompt$ echo $today
Fri Sep 23
prompt$
```

“Backward” quotes

- Are completely different from single and double quotes
- Use the accent character (usually, on your tilde key)
- Usage:

```
‘command‘
```

- Replaces the string with the output of the command
  - Whatever would have been written to standard output

```
prompt$ today=‘date | head -c 10‘
prompt$ echo $today
Fri Sep 23
prompt$ echo "The current time is ‘date | tail -c +11 | head -c 9‘"
```

“Backward” quotes

- Are completely different from single and double quotes
- Use the accent character (usually, on your tilde key)
- Usage:

```
‘command‘
```

- Replaces the string with the output of the command
  - Whatever would have been written to standard output

```
prompt$ today=‘date | head -c 10‘
prompt$ echo $today
Fri Sep 23
prompt$ echo "The current time is ‘date | tail -c +11 | head -c 9‘"
The current time is  12:03:27
prompt$ █
```

Alternate syntax for “backward” quotes

```
$(command)
```

does the same thing as

```
`command`
```

For example:

```
prompt$ █
```

Alternate syntax for “backward” quotes

```
$(command)
```

does the same thing as

```
`command`
```

For example:

```
prompt$ firstfile=$(ls | head -n 1)
```

Alternate syntax for “backward” quotes

```
$(command)
```

does the same thing as

```
`command`
```

For example:

```
prompt$ firstfile=$(ls | head -n 1)
prompt$ █
```

Alternate syntax for “backward” quotes

```
$(command)
```

does the same thing as

```
`command`
```

For example:

```
prompt$ firstfile=$(ls | head -n 1)
prompt$ echo "The first file is $firstfile"
```

Alternate syntax for “backward” quotes

```
$(command)
```

does the same thing as

```
‘command‘
```

For example:

```
prompt$ firstfile=$(ls | head -n 1)
prompt$ echo "The first file is $firstfile"
The first file is bar.txt
prompt$ 
```

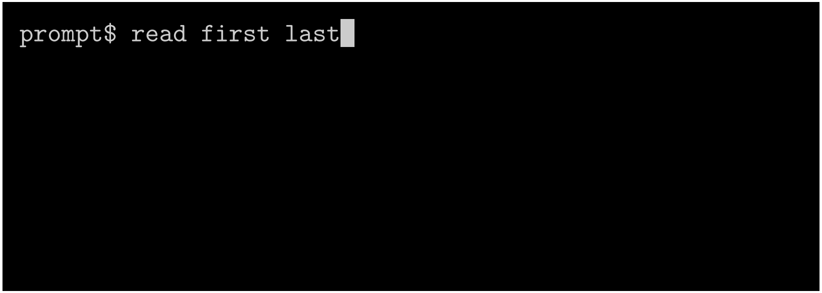
Quotes with read

- Will quotes collect a string together, for read?

```
prompt$ █
```

Quotes with `read`

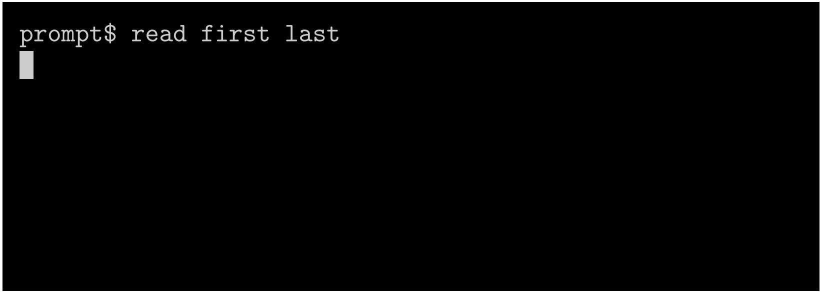
- Will quotes collect a string together, for `read`?



```
prompt$ read first last
```

Quotes with `read`

- Will quotes collect a string together, for `read`?



```
prompt$ read first last
█
```

Quotes with read

- Will quotes collect a string together, for read?

```
prompt$ read first last
"The artist" "formerly known as Prince"
```

Quotes with `read`

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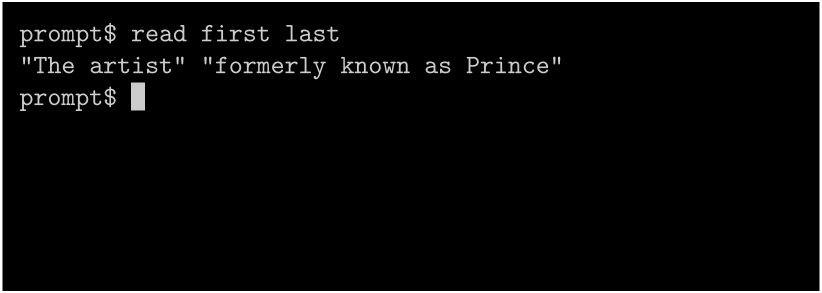

```
prompt$ read first last
"The artist" "formerly known as Prince"
prompt$ 
```

Quotes with `read`

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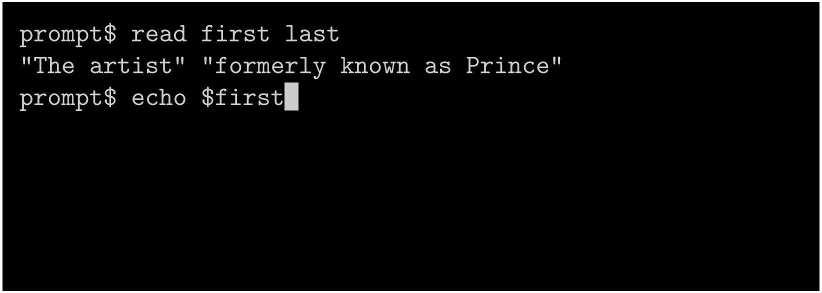
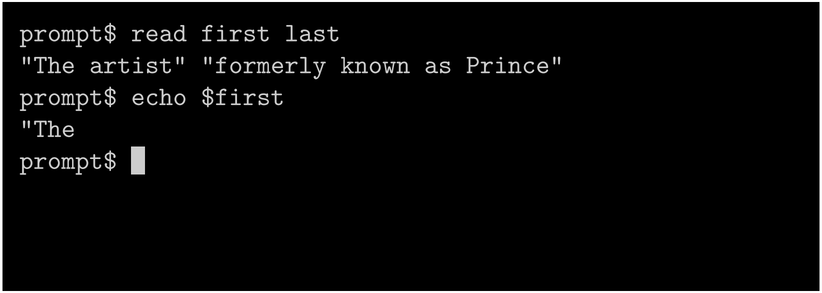


```
prompt$ read first last
"The artist" "formerly known as Prince"
prompt$ echo $first
```

Quotes with `read`

- Will quotes collect a string together, for `read`?
  - No



```
prompt$ read first last
"The artist" "formerly known as Prince"
prompt$ echo $first
"The
prompt$
```

Quotes with `read`

- Will quotes collect a string together, for `read`?
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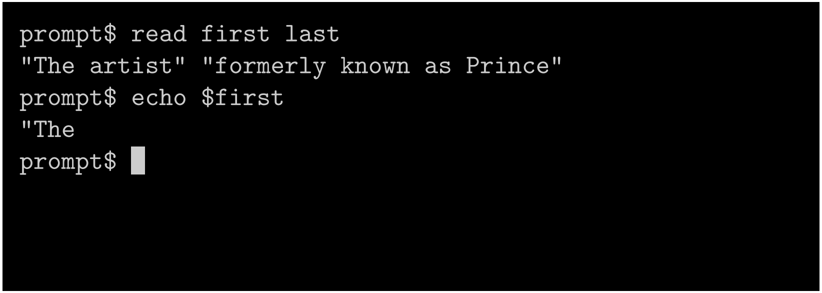
- How can we collect a few words together, for `read`?



```
prompt$ read first last
"The artist" "formerly known as Prince"
prompt$ echo $first
"The
prompt$ 
```

Quotes with `read`

- Will quotes collect a string together, for `read`?
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- How can we collect a few words together, for `read`?
  - Escape the spaces

```
prompt$ read first last
"The artist" "formerly known as Prince"
prompt$ echo $first
"The
prompt$ █
```

Quotes with `read`

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```
prompt$ read first last
"The artist" "formerly known as Prince"
prompt$ echo $first
"The
prompt$ read first middle last
```

Quotes with read

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The\ artist formerly\ known\ as Prince
prompt$ 
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prompt$ read first last
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"The
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The\ artist formerly\ known\ as Prince
prompt$ echo $first
```

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```
"The artist" "formerly known as Prince"
prompt$ echo $first
"The
prompt$ read first middle last
The\ artist formerly\ known\ as Prince
prompt$ echo $first
The artist
prompt$ █
```

Quotes with read

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  - No
- How can we collect a few words together, for read?
  - Escape the spaces

```
"The artist" "formerly known as Prince"
prompt$ echo $first
"The
prompt$ read first middle last
The\ artist formerly\ known\ as Prince
prompt$ echo $first
The artist
prompt$ echo $middle
```

Quotes with `read`

- Will quotes collect a string together, for `read`?
  - No
- How can we collect a few words together, for `read`?
  - Escape the spaces

```
"The
prompt$ read first middle last
The\ artist formerly\ known\ as Prince
prompt$ echo $first
The artist
prompt$ echo $middle
formerly known as
prompt$ █
```

Quotes with read

- Will quotes collect a string together, for read?
  - No
- How can we collect a few words together, for read?
  - Escape the spaces

```
"The
prompt$ read first middle last
The\ artist formerly\ known\ as Prince
prompt$ echo $first
The artist
prompt$ echo $middle
formerly known as
prompt$ echo $last
```

Quotes with read

- Will quotes collect a string together, for `read`?
  - No
- How can we collect a few words together, for `read`?
  - Escape the spaces

```
The\ artist formerly\ known\ as Prince
prompt$ echo $first
The artist
prompt$ echo $middle
formerly known as
prompt$ echo $last
Prince
prompt$ █
```

What is an alias?

- An *alias* allows us to specify our own (simple) shell builtins
- Use the same naming rule as shell variables
- Are defined similar to shell variables
- May have the same name as an existing "command"
- Are used by typing the name as a "command"
  - Without a leading $
  - Are substituted *only* when treated as a "command"

`alias`: set and display aliases

- `alias`
  - Display all known aliases
- `alias NAME`
  - Display the alias defined for `NAME`
  - Prints an error, if none
- `alias NAME=command`
  - Sets the alias for `NAME`
  - Use quotes to collect a string, as usual
  - May contain other aliases...
  - ...but must eventually resolve to a "real command"

`unalias`: remove an alias

- Usage: `unalias NAME1 NAME2 ...`
- Prints an error, if some `NAME` is not an existing alias

Alias examples

```
prompt$ █
```

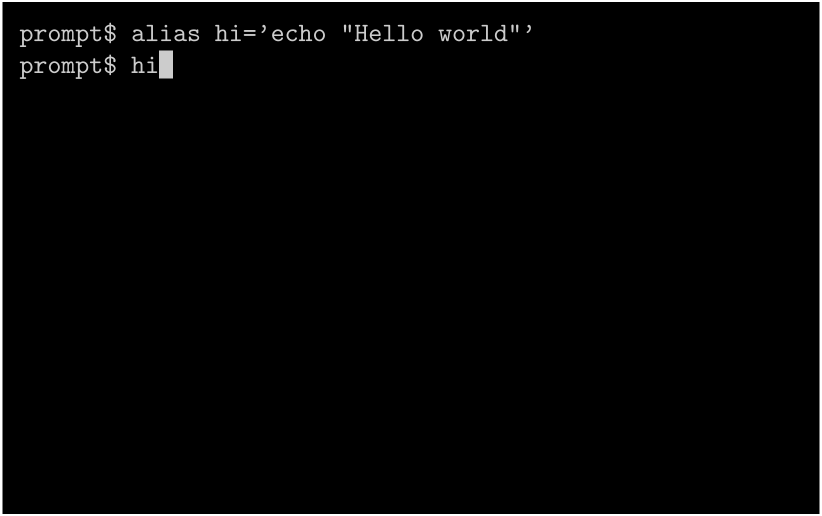
Alias examples

```
prompt$ alias hi='echo "Hello world"'
```

Alias examples

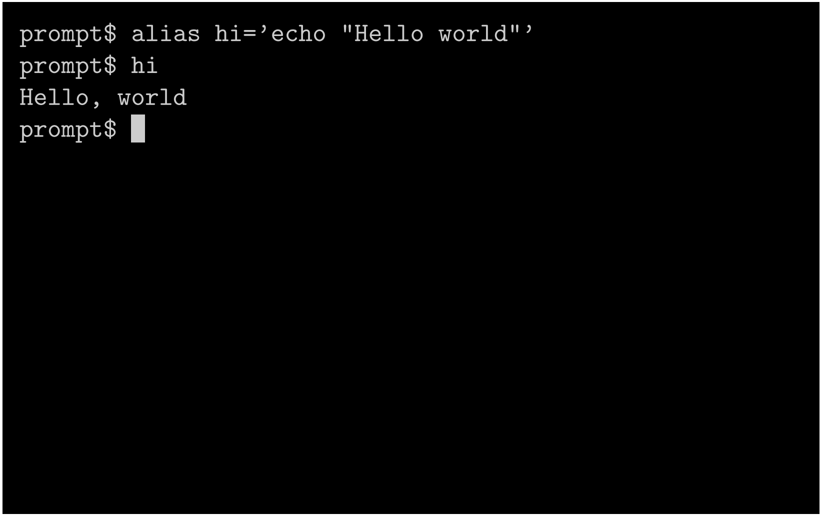
```
prompt$ alias hi='echo "Hello world"'
prompt$ 
```

Alias examples



```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
```

Alias examples



```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ 
```

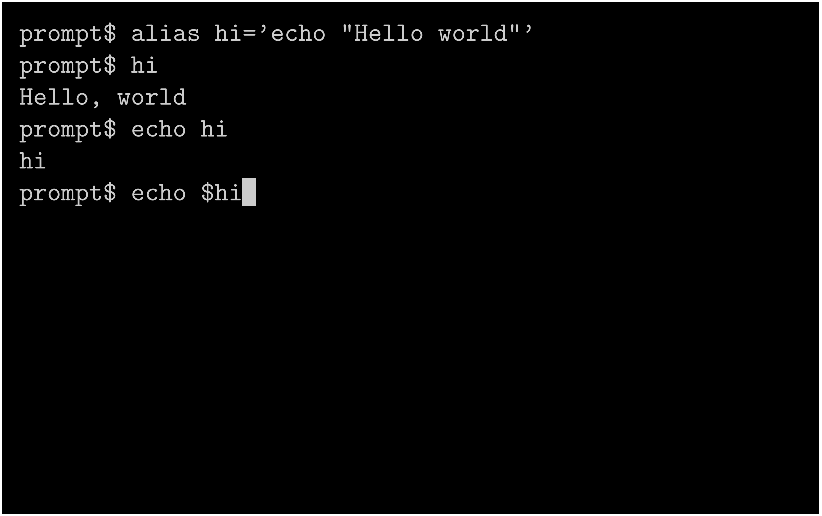
Alias examples

```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
```

Alias examples

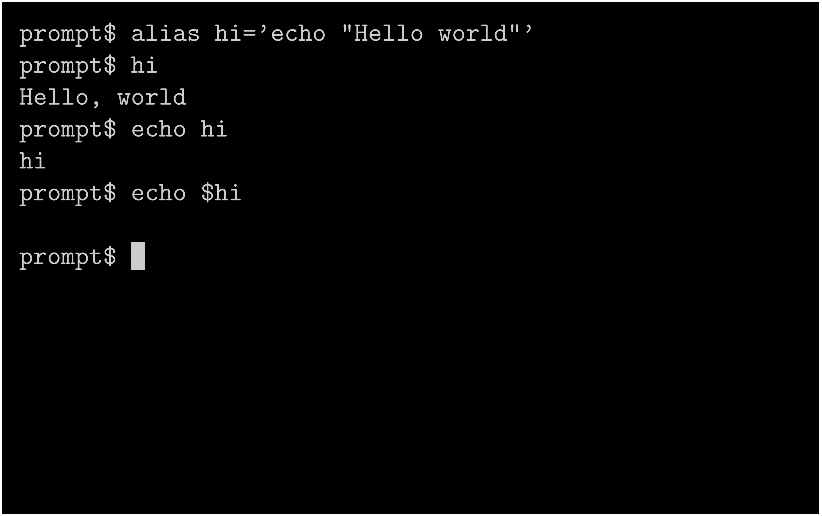
```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ █
```

Alias examples



```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi
```

Alias examples



```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ 
```

Alias examples

```
prompt$ alias hi=’echo "Hello world"’
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
```

Alias examples

```
prompt$ alias hi=’echo "Hello world"’
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi=’echo "Hello world"’
prompt$ 
```

Alias examples

```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi='echo "Hello world"'
prompt$ unalias hi
```

Alias examples

```
prompt$ alias hi=’echo "Hello world"’
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi=’echo "Hello world"’
prompt$ unalias hi
prompt$ █
```

Alias examples

```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi='echo "Hello world"'
prompt$ unalias hi
prompt$ hi
```

Alias examples

```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi='echo "Hello world"'
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ █
```

Alias examples

```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi='echo "Hello world"'
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
```

Alias examples

```
prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi='echo "Hello world"'
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
prompt$ █
```

Alias examples

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prompt$ alias hi='echo "Hello world"'
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi='echo "Hello world"'
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
prompt$ alias ls="ls -aF --color"
```

Alias examples

```
prompt$ alias hi=’echo "Hello world"’
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi=’echo "Hello world"’
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
prompt$ alias ls="ls -aF --color"
prompt$ █
```

Alias examples

```
prompt$ alias hi=’echo "Hello world"’
prompt$ hi
Hello, world
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi=’echo "Hello world"’
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
prompt$ alias ls="ls -aF --color"
prompt$ ls
```

Alias examples

```
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi='echo "Hello world"'
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
prompt$ alias ls="ls -aF --color"
prompt$ ls
./        bar.txt   foo.txt   Readme
../       .bashrc   hello.c   .ssh/
prompt$ 
```

Alias examples

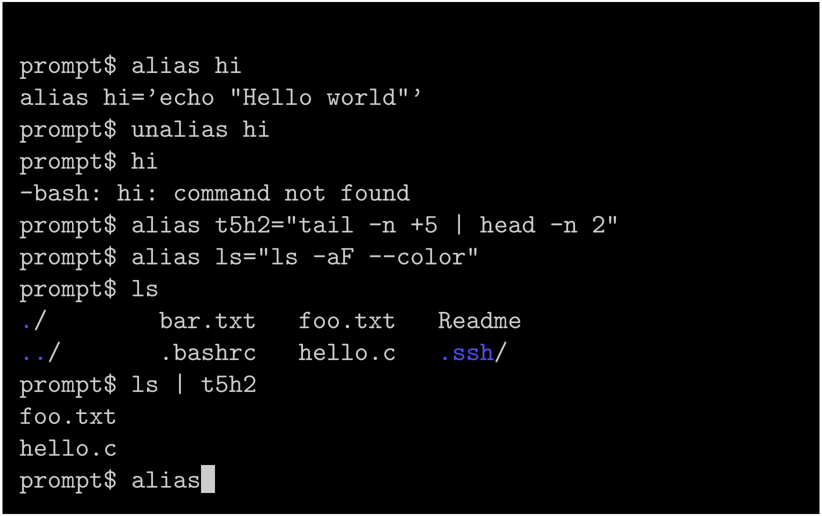
```
prompt$ echo hi
hi
prompt$ echo $hi

prompt$ alias hi
alias hi=’echo "Hello world"’
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
prompt$ alias ls="ls -aF --color"
prompt$ ls
./        bar.txt   foo.txt   Readme
../       .bashrc   hello.c   .ssh/
prompt$ ls | t5h2
```

Alias examples

```
prompt$ alias hi
alias hi='echo "Hello world"'
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
prompt$ alias ls="ls -aF --color"
prompt$ ls
./         bar.txt    foo.txt    Readme
../        .bashrc    hello.c    .ssh/
prompt$ ls | t5h2
foo.txt
hello.c
prompt$ █
```

Alias examples



```
prompt$ alias hi
alias hi='echo "Hello world"'
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
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prompt$ ls
./         bar.txt   foo.txt   Readme
../        .bashrc   hello.c   .ssh/
prompt$ ls | t5h2
foo.txt
hello.c
prompt$ alias
```

Alias examples

```
prompt$ unalias hi
prompt$ hi
-bash: hi: command not found
prompt$ alias t5h2="tail -n +5 | head -n 2"
prompt$ alias ls="ls -aF --color"
prompt$ ls
./          bar.txt   foo.txt   Readme
../         .bashrc   hello.c   .ssh/
prompt$ ls | t5h2
foo.txt
hello.c
prompt$ alias
alias ls='ls -aF --color'
alias t5h2='tail -n +5 | head -n 2'
prompt$ █
```

Evil prank

Do this next time your friend leaves a machine unattended

1. `alias ls='echo "No files."'`
2. When they get back:
   “Hey, someone came over and deleted all your files.”

Evil prank

Do this next time your friend leaves a machine unattended

1. `alias ls='echo "No files."'`
2. When they get back:
   "Hey, someone came over and deleted all your files."

Important lesson: never leave your machine unattended

- Always lock your screen
- Prevents these pranks
- Prevents much more sinister actions
- You can be fired for leaving your account unlocked

Exporting variables

- Exported shell variables are copied into children processes
  - *Any* process, not just another shell
- To export a shell variable

```
export VARNAME
```

- You can export and define a variable at the same time

```
export VARNAME=value
```

- To see a list of exported variables

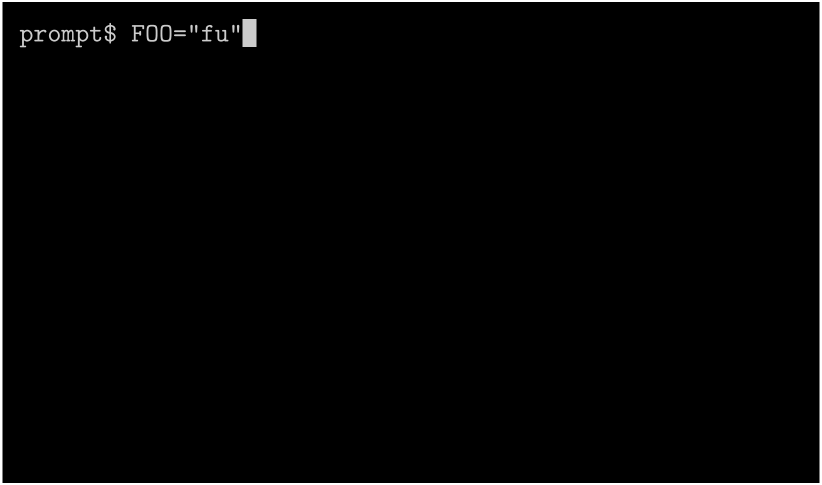
```
export
```

- By convention, exported variable names are all caps

export example

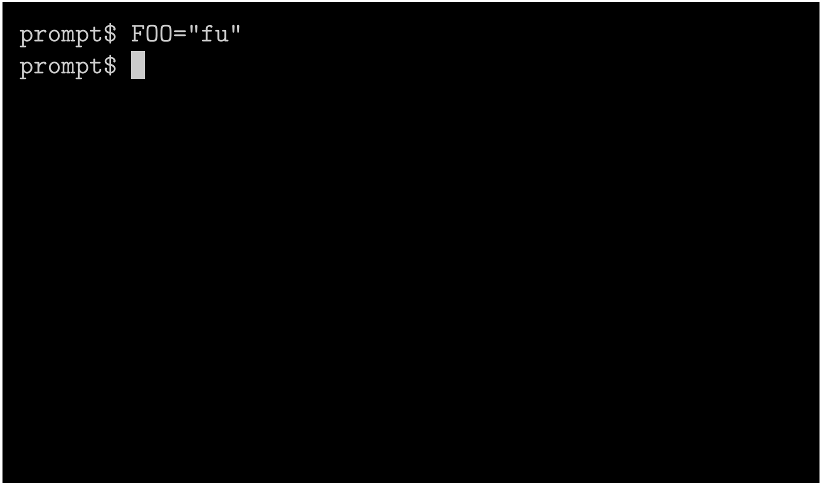
```
prompt$ █
```

export example



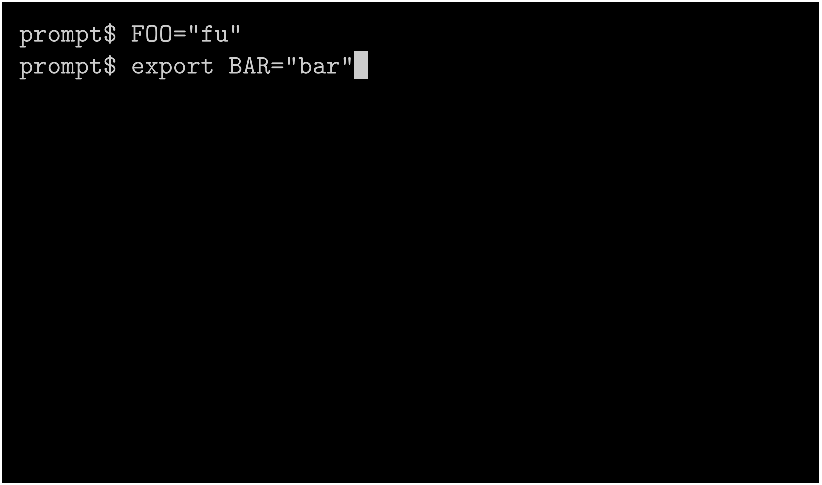
```
prompt$ FOO="fu"
```

export example



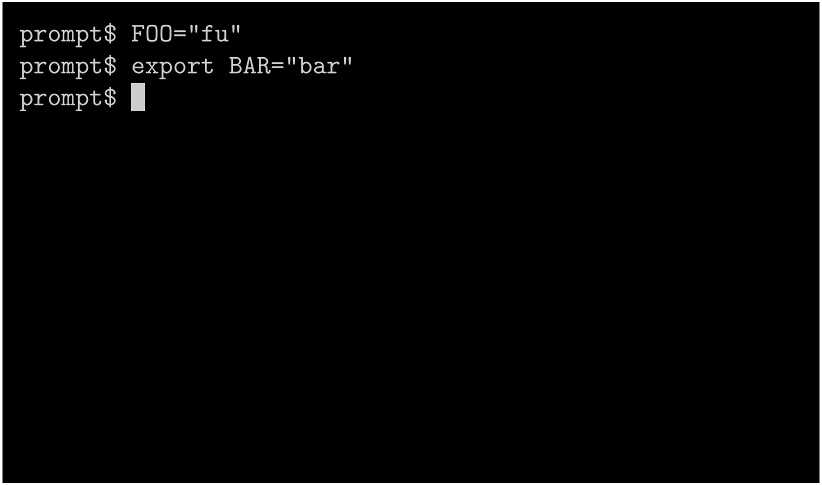
```
prompt$ FOO="fu"
prompt$ 
```

export example



```
prompt$ FOO="fu"
prompt$ export BAR="bar"
```

export example



```
prompt$ FOO="fu"
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prompt$ 
```
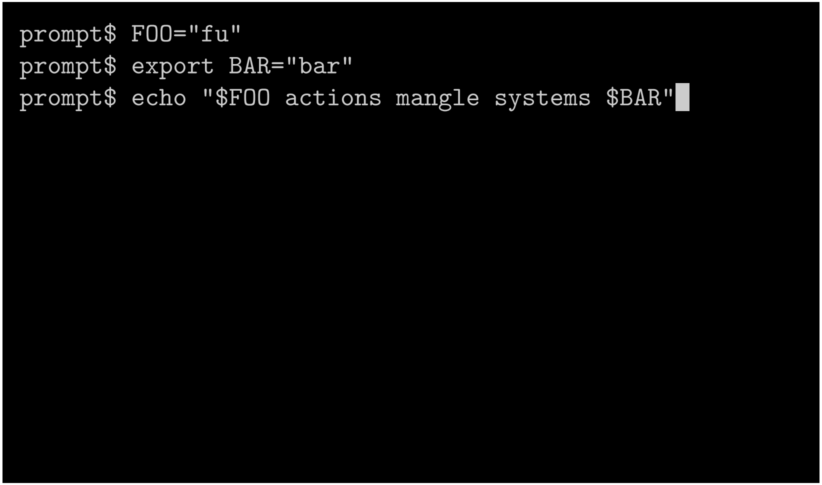

export example

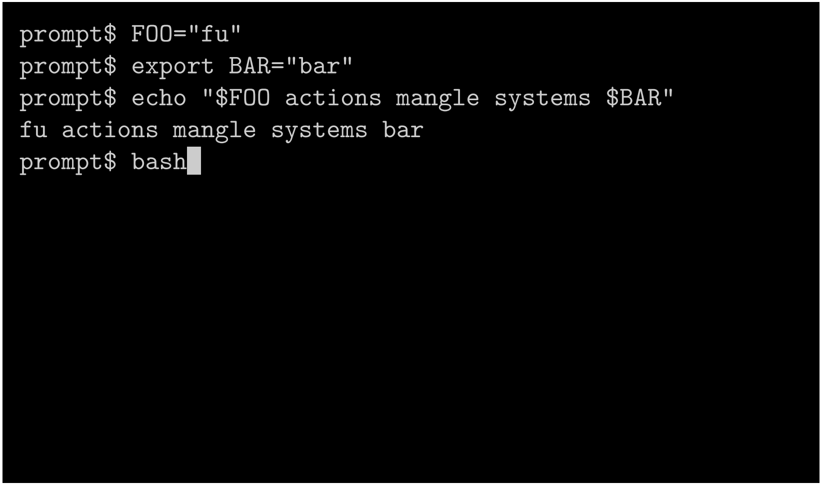


```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
```

export example

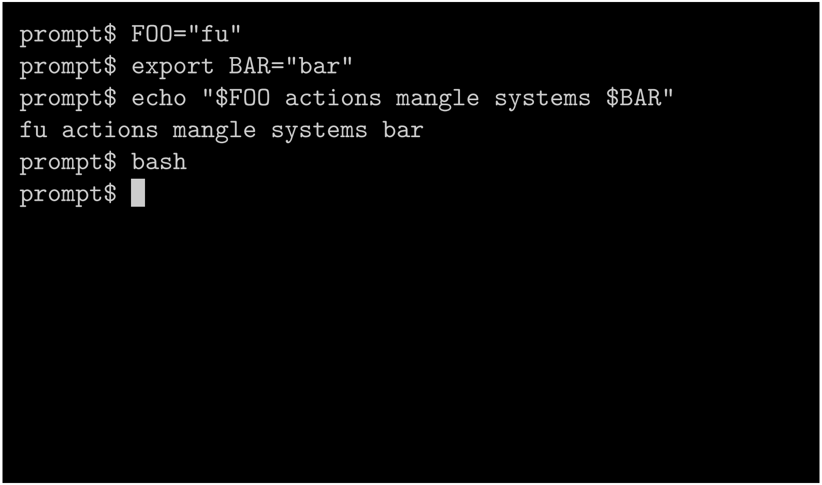
```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ █
```

export example



```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
```

export example



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prompt$ FOO="fu"
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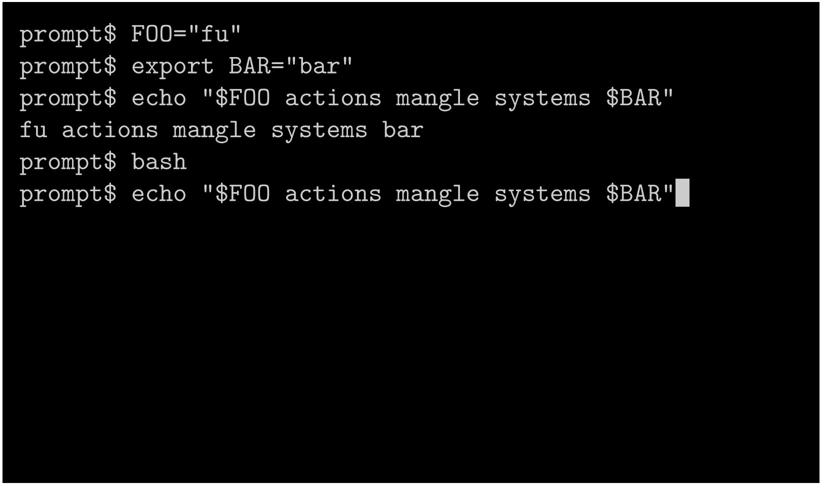
fu actions mangle systems bar
prompt$ bash
prompt$ 
```

export example



```
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prompt$ export BAR="bar"
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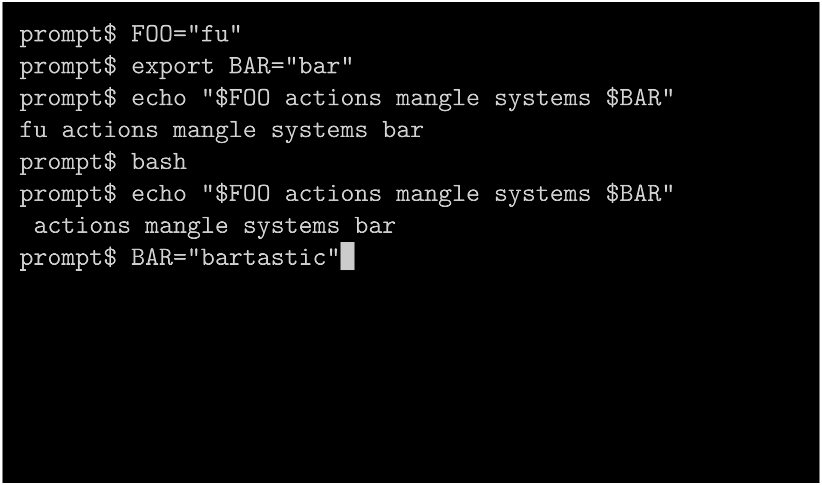
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
```

export example

```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
 actions mangle systems bar
prompt$ █
```

export example



```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
 actions mangle systems bar
prompt$ BAR="bartastic"
```

export example

```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
 actions mangle systems bar
prompt$ BAR="bartastic"
prompt$ █
```

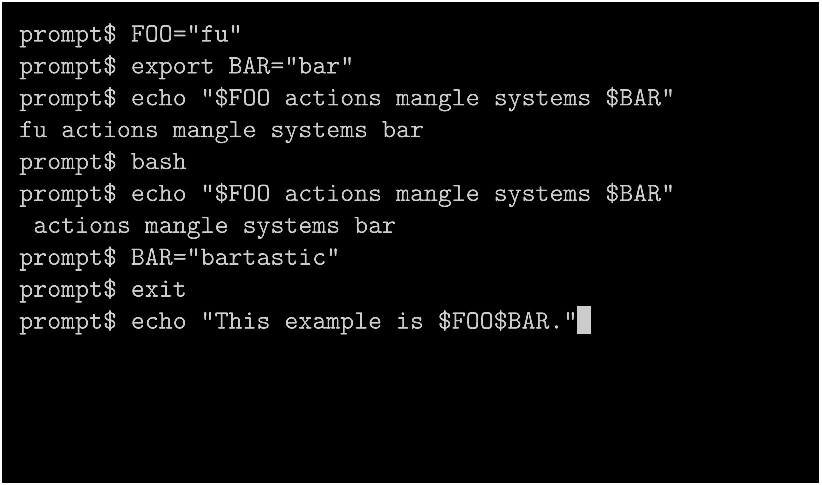
export example

```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
 actions mangle systems bar
prompt$ BAR="bartastic"
prompt$ exit
```

export example

```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
 actions mangle systems bar
prompt$ BAR="bartastic"
prompt$ exit
prompt$ █
```

export example



```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
 actions mangle systems bar
prompt$ BAR="bartastic"
prompt$ exit
prompt$ echo "This example is $FOO$BAR."
```

export example

```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
 actions mangle systems bar
prompt$ BAR="bartastic"
prompt$ exit
prompt$ echo "This example is $FOO$BAR."
This example is fubar.
prompt$ 
```

export example

```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
 actions mangle systems bar
prompt$ BAR="bartastic"
prompt$ exit
prompt$ echo "This example is $FOO$BAR."
This example is fubar.
prompt$ export
```

export example

```
prompt$ FOO="fu"
prompt$ export BAR="bar"
prompt$ echo "$FOO actions mangle systems $BAR"
fu actions mangle systems bar
prompt$ bash
prompt$ echo "$FOO actions mangle systems $BAR"
 actions mangle systems bar
prompt$ BAR="bartastic"
prompt$ exit
prompt$ echo "This example is $FOO$BAR."
This example is fubar.
prompt$ export
declare -x BAR="bar"
prompt$ 
```

Environment

- The collection of exported variables is called the environment
- Can be used to adjust behavior of applications
  - Remember, any process has access to the environment
  - In C, use

```
int main(int argc, char** argv, char** env)
```

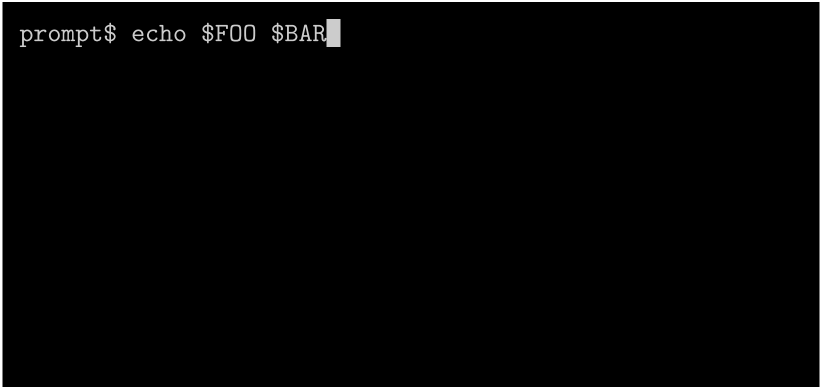
env: manage the environment

- Usage: `env [name=value] ...[name=value] [cmd args]`
- Run "`cmd args`" with an adjusted environment
- If no "`cmd`" is given, display the environment

env example

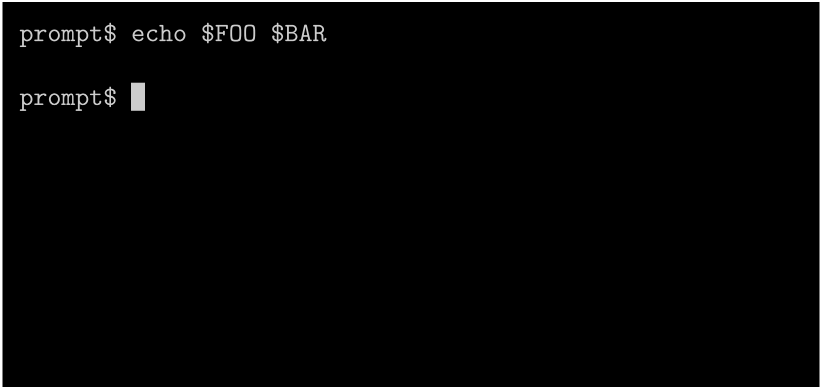
```
prompt$
```

env example



```
prompt$ echo $FOO $BAR
```

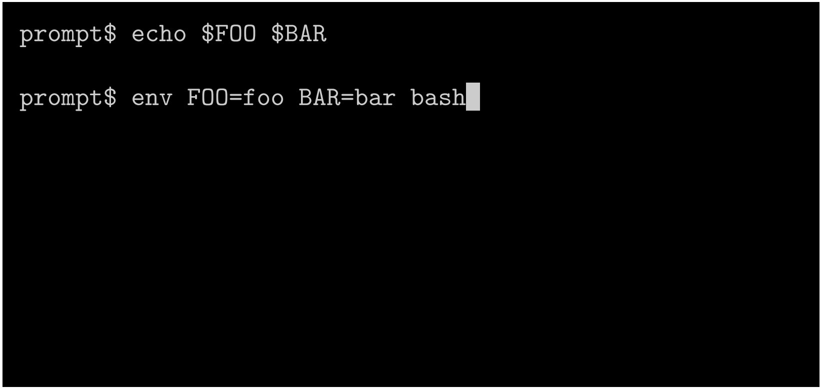
env example



```
prompt$ echo $FOO $BAR

prompt$ 
```

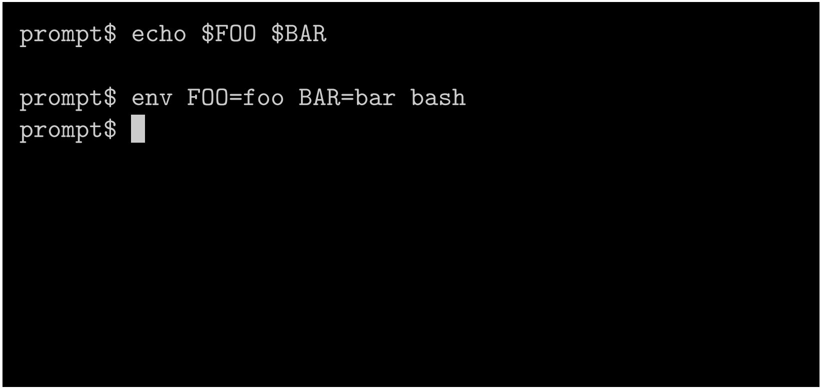
env example



```
prompt$ echo $FOO $BAR

prompt$ env FOO=foo BAR=bar bash
```

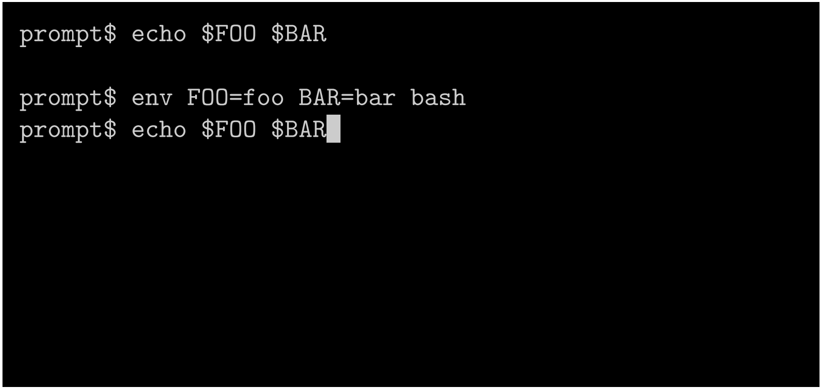
env example



```
prompt$ echo $FOO $BAR

prompt$ env FOO=foo BAR=bar bash
prompt$ 
```

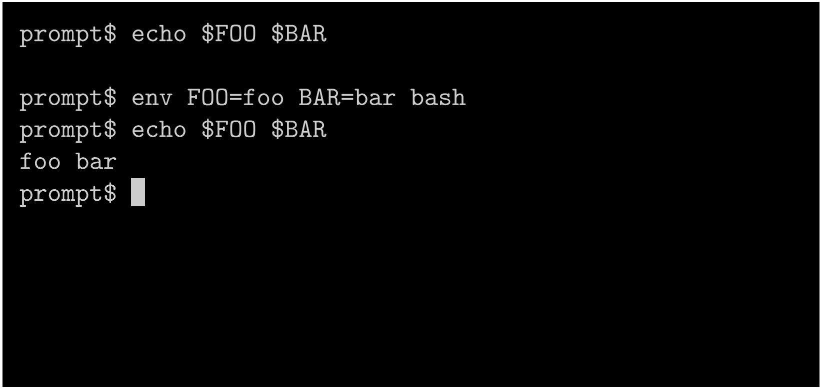
env example



```
prompt$ echo $FOO $BAR

prompt$ env FOO=foo BAR=bar bash
prompt$ echo $FOO $BAR
```

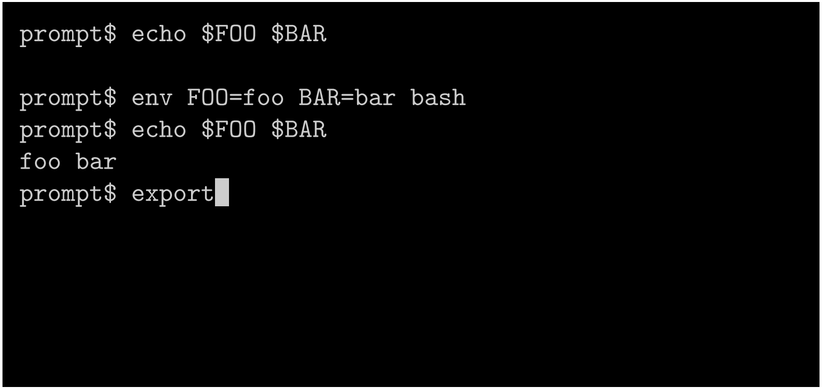
env example



```
prompt$ echo $FOO $BAR

prompt$ env FOO=foo BAR=bar bash
prompt$ echo $FOO $BAR
foo bar
prompt$
```

env example



```
prompt$ echo $FOO $BAR

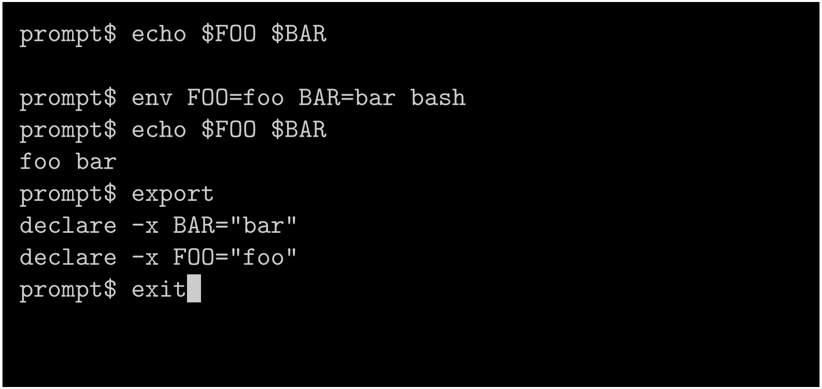
prompt$ env FOO=foo BAR=bar bash
prompt$ echo $FOO $BAR
foo bar
prompt$ export
```

env example

```
prompt$ echo $FOO $BAR

prompt$ env FOO=foo BAR=bar bash
prompt$ echo $FOO $BAR
foo bar
prompt$ export
declare -x BAR="bar"
declare -x FOO="foo"
prompt$ 
```

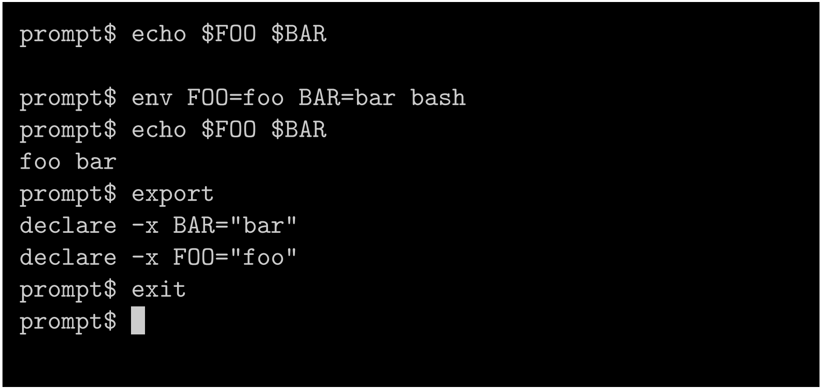
env example



```
prompt$ echo $FOO $BAR

prompt$ env FOO=foo BAR=bar bash
prompt$ echo $FOO $BAR
foo bar
prompt$ export
declare -x BAR="bar"
declare -x FOO="foo"
prompt$ exit
```

env example



```
prompt$ echo $FOO $BAR

prompt$ env FOO=foo BAR=bar bash
prompt$ echo $FOO $BAR
foo bar
prompt$ export
declare -x BAR="bar"
declare -x FOO="foo"
prompt$ exit
prompt$ 
```

env example

```
prompt$ echo $FOO $BAR

prompt$ env FOO=foo BAR=bar bash
prompt$ echo $FOO $BAR
foo bar
prompt$ export
declare -x BAR="bar"
declare -x FOO="foo"
prompt$ exit
prompt$ export
```

env example

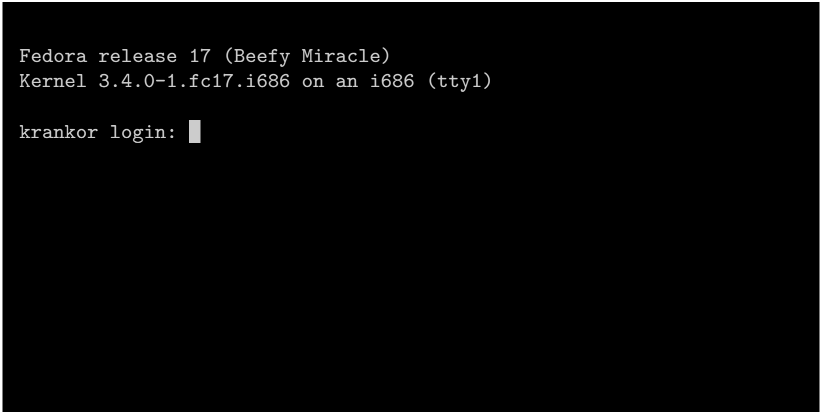
```
prompt$ echo $FOO $BAR

prompt$ env FOO=foo BAR=bar bash
prompt$ echo $FOO $BAR
foo bar
prompt$ export
declare -x BAR="bar"
declare -x FOO="foo"
prompt$ exit
prompt$ export
prompt$ █
```

Reality check

- The previous examples were "convenient fiction"
  - Benefit of the canned examples
  - I will occasionally "withhold the whole truth" from you
- Your actual shell environment will have many variables defined
- But why?
  - Environment variables are used to tweak utilities
  - Saves you from having to type switches every time
  - Example: the `$PAGER` environment variable
    - Specify your favorite pager
    - Used by utilities (like `man`) that pipe things through pagers
    - May not be present — most will default to "`less`"

Fun with environment variables[2]

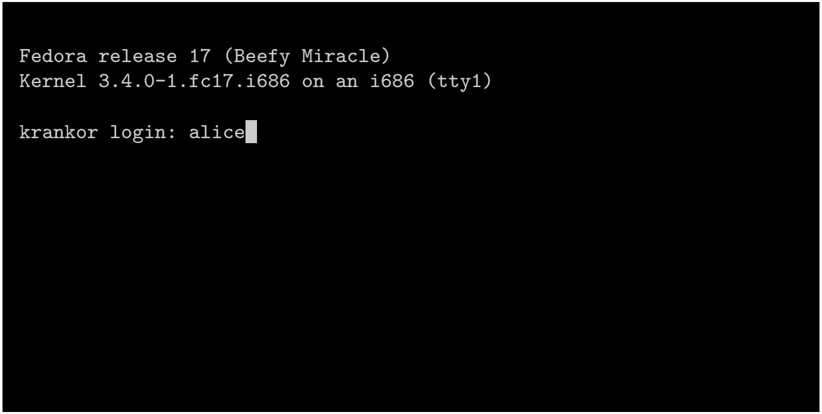


```
Fedora release 17 (Beefy Miracle)
Kernel 3.4.0-1.fc17.i686 on an i686 (tty1)

krankor login: 
```

[2] Even this is not the “whole” truth...

Fun with environment variables[2]



```
Fedora release 17 (Beefy Miracle)
Kernel 3.4.0-1.fc17.i686 on an i686 (tty1)

krankor login: alice
```

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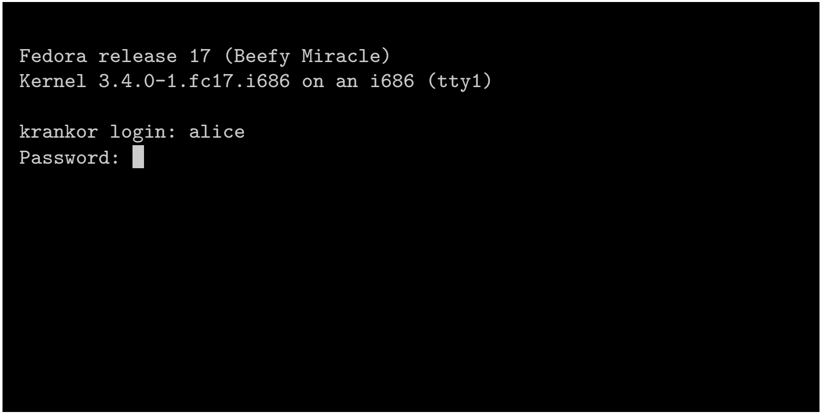
Fun with environment variables[2]



```
Fedora release 17 (Beefy Miracle)
Kernel 3.4.0-1.fc17.i686 on an i686 (tty1)

krankor login: alice
Password: 
```

[2] Even this is not the "whole" truth...

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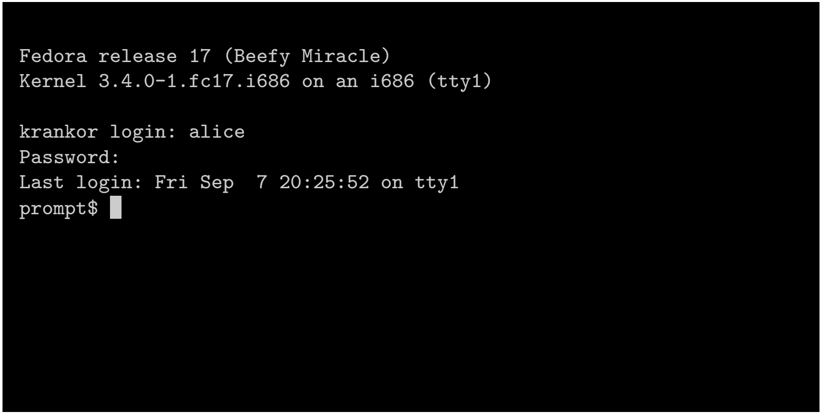
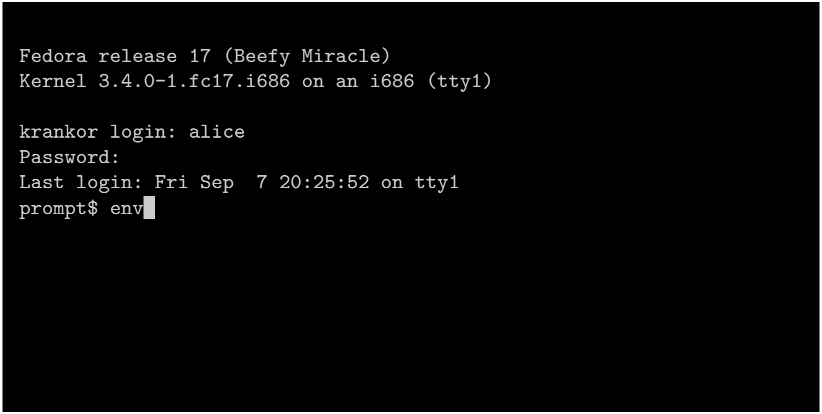


```
Fedora release 17 (Beefy Miracle)
Kernel 3.4.0-1.fc17.i686 on an i686 (tty1)

krankor login: alice
Password:
Last login: Fri Sep  7 20:25:52 on tty1
prompt$
```

[2] Even this is not the "whole" truth. . .

Fun with environment variables[2]



```
Fedora release 17 (Beefy Miracle)
Kernel 3.4.0-1.fc17.i686 on an i686 (tty1)

krankor login: alice
Password:
Last login: Fri Sep  7 20:25:52 on tty1
prompt$ env
```

[2] Even this is not the “whole” truth. . .

Fun with environment variables[2]

```
Password:
Last login: Fri Sep  7 20:25:52 on tty1
prompt$ env
HOSTNAME=krankor
TERM=linux
SHELL=/bin/bash
USER=alice
MAIL=/var/spool/mail/alice
PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ █
```

[2] Even this is not the “whole” truth. . .

Fun with environment variables[2]

```
Password:
Last login: Fri Sep  7 20:25:52 on tty1
prompt$ env
HOSTNAME=krankor
TERM=linux
SHELL=/bin/bash
USER=alice
MAIL=/var/spool/mail/alice
PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
```

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Fun with environment variables[2]

```
Last login: Fri Sep  7 20:25:52 on tty1
prompt$ env
HOSTNAME=krankor
TERM=linux
SHELL=/bin/bash
USER=alice
MAIL=/var/spool/mail/alice
PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ █
```

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USER=alice
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PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
```

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Fun with environment variables[2]

```
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HOSTNAME=krankor
TERM=linux
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HOME=/home/alice
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PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
```

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HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ █
```

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Fun with environment variables[2]

```
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USER=alice
MAIL=/var/spool/mail/alice
PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
```

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Fun with environment variables[2]

```
SHELL=/bin/bash
USER=alice
MAIL=/var/spool/mail/alice
PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
prompt$ 
```

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Fun with environment variables[2]

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SHELL=/bin/bash
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PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
prompt$ man man
```

[2] Even this is not the “whole” truth. . .

Fun with environment variables[2]

```
PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
prompt$ man man
MAN(1)                    Manual pager utils                   MAN(1)

prompt$
```

[2] Even this is not the “whole” truth…

Fun with environment variables[2]

```
PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
prompt$ man man
MAN(1)                    Manual pager utils                  MAN(1)

prompt$ PATH=""
```

[2]Even this is not the "whole" truth. . .

Fun with environment variables[2]

```
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
prompt$ man man
MAN(1)                    Manual pager utils                    MAN(1)

prompt$ PATH=""
prompt$ █
```

[2] Even this is not the "whole" truth. . .

Fun with environment variables[2]

```
PWD=/home/alice
HOME=/home/alice
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
prompt$ man man
MAN(1)                    Manual pager utils                    MAN(1)

prompt$ PATH=""
prompt$ ls /home/alice
```

[2] Even this is not the "whole" truth...

Fun with environment variables[2]

```
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
prompt$ man man
MAN(1)                    Manual pager utils                    MAN(1)

prompt$ PATH=""
prompt$ ls /home/alice
-bash: ls: No such file or directory
prompt$ █
```

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Fun with environment variables[2]

```
LOGNAME=alice
PAGER=/bin/less
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
prompt$ man man
MAN(1)                    Manual pager utils                    MAN(1)

prompt$ PATH=""
prompt$ ls /home/alice
-bash: ls: No such file or directory
prompt$ /bin/ls /home/alice
```

[2]Even this is not the "whole" truth...

Fun with environment variables[2]

```
_=/bin/env
prompt$ HOME=/etc
prompt$ cd ~
prompt$ pwd
/etc
prompt$ PAGER="/bin/head -n 2"
prompt$ man man
MAN(1)                    Manual pager utils                    MAN(1)

prompt$ PATH=""
prompt$ ls /home/alice
-bash: ls: No such file or directory
prompt$ /bin/ls /home/alice
bar.txt   foo.txt   hello.c   README
prompt$ 
```

[2] Even this is not the "whole" truth...

Your `PATH`

Remember: there are two types of "commands"

1. Shell "builtins": managed by the shell
2. Executables that live somewhere (like, `ls`)

Your PATH

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If you specify a directory, the shell just tries that one. Otherwise:

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How does the shell know where to look for an executable?

If you specify a directory, the shell just tries that one. Otherwise:

- The `PATH` variable specifies a list of directories
- The shell checks those directories in order
- First matching executable is the one that runs

Your PATH

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What does the shell do when the command is not built–in?

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How does the shell know where to look for an executable?

If you specify a directory, the shell just tries that one. Otherwise:

- The `PATH` variable specifies a list of directories
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- First matching executable is the one that runs

Be careful with your `PATH`. More on this later...

How can I set things for *every* shell I start

How can I set things for *every* shell I start

Easy — edit your `.bashrc` file

- In your home directory
- Sometimes has another name, so check your `man` pages
- Is an ordinary text file
- The file contains `bash` "commands"
  - Anything you could type in a `bash` shell
- This file is executed whenever you start a shell
  - There are switches to change this...

Sample .bashrc file (well, part of one)

```
prompt$ █
```

Sample .bashrc file (well, part of one)

```
prompt$ cat .bashrc
```

Sample .bashrc file (well, part of one)

```
umask 077

alias cp='cp -i'
alias mv='mv -i'
alias rm='rm -i'
alias ls='ls -aF --color'
alias man='man -a'

export SVN_EDITOR="/usr/bin/vim"

export PATH=$PATH:~/bin

prompt$
```

Arithmetic in bash

expr: evaluate an expression

- The expression is passed as arguments
- Each term of the expression must be its own argument
  - Be sure to leave spaces everywhere
- Allowed operators:

  +, -, *, /, %, |, &,

  <, <=, >, >=, =, !=
- Can use parentheses to group
- Check your man pages for more details
- Be careful with shell special characters

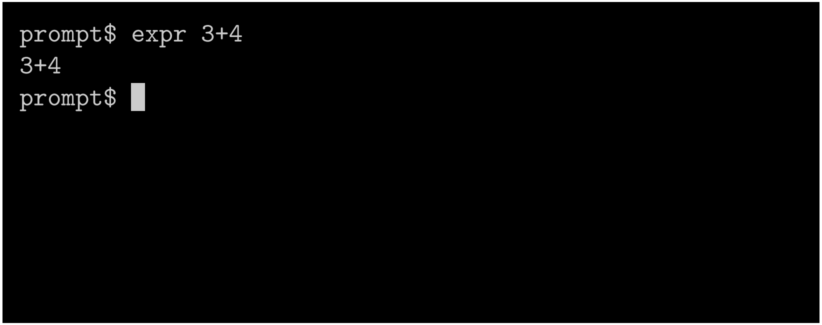
expr examples

```
prompt$
```

expr examples

```
prompt$ expr 3+4
```

expr examples



```
prompt$ expr 3+4
3+4
prompt$ 
```

What happened?

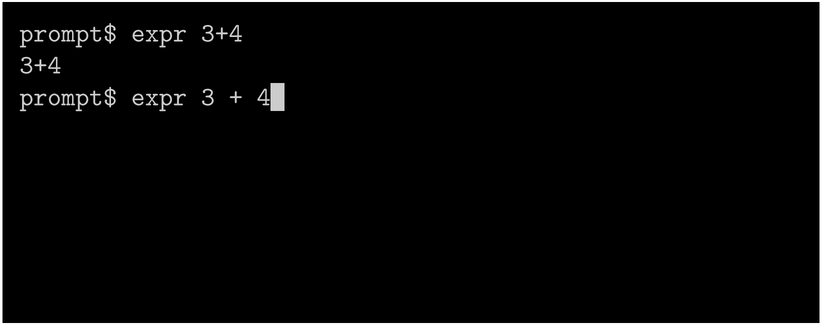
expr examples

```
prompt$ expr 3+4
3+4
prompt$ █
```

What happened?

Need spaces between terms

expr examples



```
prompt$ expr 3+4
3+4
prompt$ expr 3 + 4
```

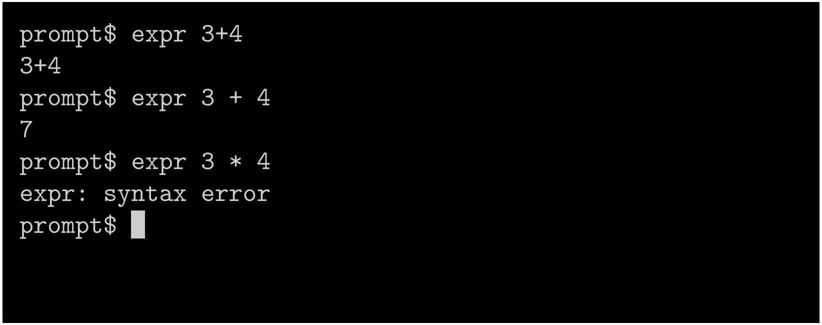
expr examples

```
prompt$ expr 3+4
3+4
prompt$ expr 3 + 4
7
prompt$ 
```

expr examples

```
prompt$ expr 3+4
3+4
prompt$ expr 3 + 4
7
prompt$ expr 3 * 4
```

expr examples



```
prompt$ expr 3+4
3+4
prompt$ expr 3 + 4
7
prompt$ expr 3 * 4
expr: syntax error
prompt$
```

What happened?

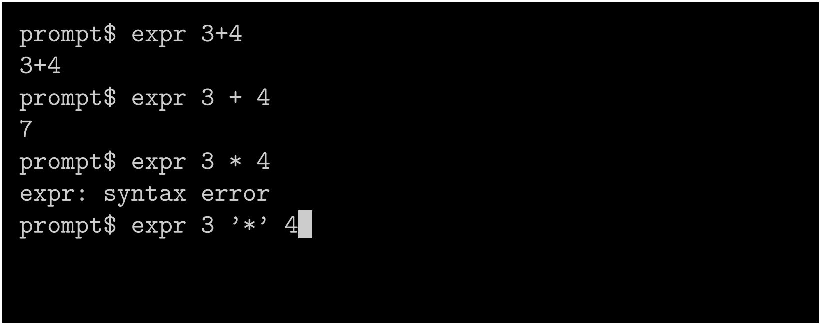
expr examples

```
prompt$ expr 3+4
3+4
prompt$ expr 3 + 4
7
prompt$ expr 3 * 4
expr: syntax error
prompt$ █
```

What happened?

"*" is replaced by files in working directory

expr examples



```
prompt$ expr 3+4
3+4
prompt$ expr 3 + 4
7
prompt$ expr 3 * 4
expr: syntax error
prompt$ expr 3 '*' 4
```

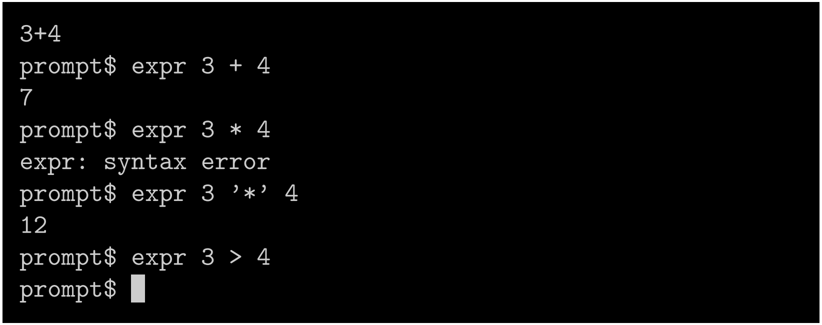
expr examples

```
prompt$ expr 3+4
3+4
prompt$ expr 3 + 4
7
prompt$ expr 3 * 4
expr: syntax error
prompt$ expr 3 '*' 4
12
prompt$ 
```

expr examples

```
prompt$ expr 3+4
3+4
prompt$ expr 3 + 4
7
prompt$ expr 3 * 4
expr: syntax error
prompt$ expr 3 '*' 4
12
prompt$ expr 3 > 4
```

expr examples



```
3+4
prompt$ expr 3 + 4
7
prompt$ expr 3 * 4
expr: syntax error
prompt$ expr 3 '*' 4
12
prompt$ expr 3 > 4
prompt$
```

What happened?

expr examples

```
3+4
prompt$ expr 3 + 4
7
prompt$ expr 3 * 4
expr: syntax error
prompt$ expr 3 '*' 4
12
prompt$ expr 3 > 4
prompt$ 
```

What happened?

">" is for redirection

expr examples

```
3+4
prompt$ expr 3 + 4
7
prompt$ expr 3 * 4
expr: syntax error
prompt$ expr 3 '*' 4
12
prompt$ expr 3 > 4
prompt$ cat 4
```

expr examples

```
7
prompt$ expr 3 * 4
expr: syntax error
prompt$ expr 3 ’*’ 4
12
prompt$ expr 3 > 4
prompt$ cat 4
3
prompt$ █
```

expr examples

```
7
prompt$ expr 3 * 4
expr: syntax error
prompt$ expr 3 '*' 4
12
prompt$ expr 3 > 4
prompt$ cat 4
3
prompt$ expr 3 \> 4
```

expr examples

```
expr: syntax error
prompt$ expr 3 '*' 4
12
prompt$ expr 3 > 4
prompt$ cat 4
3
prompt$ expr 3 \> 4
0
prompt$ █
```

Time for a quiz

- Suppose I have a shell variable, `x`
- Suppose I know it contains an integer (as a string)
- How can I increment `x`?

Time for a quiz

- Suppose I have a shell variable, `x`
- Suppose I know it contains an integer (as a string)
- How can I increment `x`?
- Using “backward quotes”:

```
x=`expr $x + 1`
```

- Using “`$(...)`”:

```
x=$(expr $x + 1)
```

Shorthand for arithmetic

Good news

```
$(expr arg1 arg2 ...  argn)
```

can be instead written as

```
$[arg1 arg2 ...  argn]
```

and the `$[...]` environment is a little nicer:

- Unnecessary to leave spaces
- Unnecessary to escape the shell special characters
- We can drop the “$” when referring to variables

Shorthand vs. longhand example

The following are equivalent:

```
y=$(expr '(' $x + 1 ')' '*' 2)
```

```
y=`expr '(' $x + 1 ')' '*' 2`
```

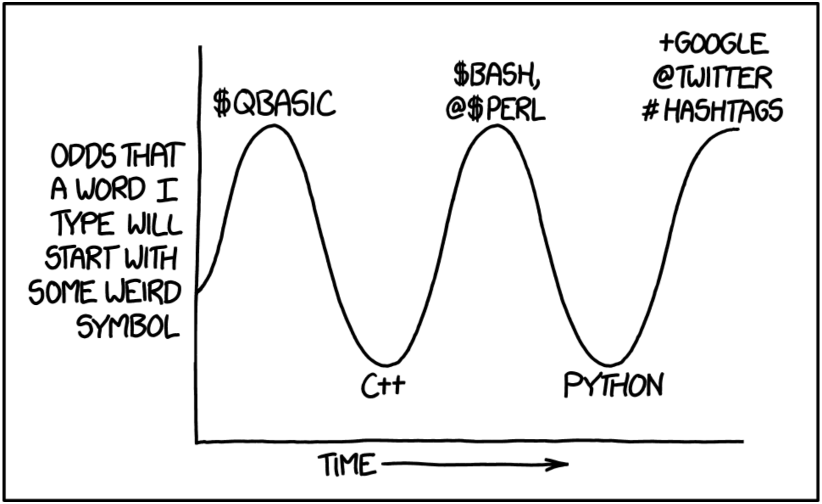
```
y=$[ ( $x + 1 ) * 2 ]
```

```
y=$[ ( x + 1 ) * 2 ]
```

```
y=$[(x+1)*2]
```

alias	manage aliases
env	manage environment
export	export shell variables
expr	evaluate an expression
read	read from standard input, into variables
unalias	remove an alias

An appropriate xkcd comic: `http://xkcd.com/1306`


ODDS THAT A WORD I TYPE WILL START WITH SOME WEIRD SYMBOL
$QBASIC
C++
$BASH, @$PERL
PYTHON
+GOOGLE @TWITTER #HASHTAGS
TIME

End of lecture