BIOINFORMATICS INSITUTE OF KENYA
PERL HACKATHON

1. **What is perl?** Perl is a loosely typed scripting programming language created by Larry Wall is 1987. Perl stands for *Practical Extraction and Reporting Language*.

2. **What are the features of Perl programming?**

i. Supports unicode
ii. Easily intergrates with databases via database intergration interface.
iii. Can be embedded in other systems.
iv. Works effeciently with markup languages

3. **What are the benefits of Perl programming in using it in biological applications?**

i. Easy to program and low learning curve.
ii. Rapid prototyping. Fast turn around time in creating applications as compared to compiled languages
iii. It is stable because it has undergone years of development.
iv. Portable: It can run on most systems. It ships preinstalled in OSX and *nix based systems.

4. **Is perl a case sensitive language?** Perl is case sensitive.

5. **What is a perl identifier**? Is a name used to identify a variable, function, class, module, or other object.

6. **What are data types that perl supports?**

i. Scalars
ii. Arrays
iii. Hashes

7. **What are scalar data types in perl?** This is a single unit of data. Usually starts with $.

```
#!/usr/bin/env perl

my $age = 50; # This is a scalar
my $name = "Albert"; # This is another scalar
```

8. **What are Arrays in perl**? This is a variable that has an ordered list of scalars. They start with (@) sign.

```
#!/usr/bin/env perl
```

```
@person1 = ("Albert", 50); # This is an array
```

9. **What are Hashes in perl**? This is a set of key value pairs.

```
#!/usr/bin/env perl

my %person1 = ('Name' => "Albert", 'Age' => 50); # This is an hash
```

10. **How will you declare a variable in perl?** Using the *my* keyword.

```
#!/usr/bin/env perl

my @variable1 = 50; # This is a scalar
my @variable2 = ("Albert", 50); # This is an array
my %varible3 = ('Name' => "Albert", 'Age' => 50); # This is an hash
```

11. **What is variable context in perl**? Variables are treated differently in perl based on the data type they are being copied.

12. **What is scalar context**? Assignment to a scalar variable evaluates the right-hand side in a scalar context.

13. **What is a list context**? Assignment to an array or a hash evaluates the right-hand side in a list context.

14. **What is a boolean context**? Boolean context is simply any place where an expression is being evaluated to see whether it's true or false.

15. **What is void context**? This context not only doesn't care what the return value is, it doesn't even want a return value.

16. **What is interpolative context**? This context only happens inside quotes, or things that work like quotes.

17. **What is the difference between single quoted string and double quoted string**? Single quotes will not resolve variables and escapes whereas double quotes will resolve variables, and escape characters.

18. **What is V-Strings?** Also known as version strings. They are used to print out version numbers.

19. **What is the purpose of a __FILE__ literal**? Used to represent the current file name in a program.

20. **What is the purpose of a __LINE__ literal**? Used to represent the current line number in a program.

21. **What is the purpose of a __PACKAGE__ literal**? Used to represent the current package name in a program.

22. **How will you access an element of a perl array**? Prefix the variable with a dollar sign ($) and then append the element index within the square brackets after the name of the variable.

```
#!/usr/bin/env perl

my @person1 = ("Albert", 50); # This is an array

print "$person1[0]\n"; # Accessing first element
print "$person1[1]\n"; # Accessing second element
```

23. **What is range operator**? Used as a shorthand way to set up arrays.

```
@array = (1..10);
```

24. **How will you get size of an array**? Using the scalar context on the array.

```
#!/usr/bin/env perl
my @array = (1,2,3);
print "Size: ",scalar @array,"\n";
```

25. **How will you add an element to an end of an array**? Using *push* keyword.

```
#!/usr/bin/env perl
my @array = (1,2,3);
push(@array, 4);
```

26. **How will you add an element to an beginning of an array**? Using *unshift* keyword.

```
#!/usr/bin/env perl
my @array = (1,2,3);
unshift(@array, 0);
```

27. **How will you remove an element to an end of an array**? Using *pop* keyword.

```
#!/usr/bin/env perl
my @array = (1,2,3);
pop(@array);
```

28. **How will you remove an element to an beginning of an array**? Using *shift* keyword.

```
#!/usr/bin/env perl
```

```
my @array = (1,2,3);
shift(@array);
```

29. **How will you get slice from an array**? One can uses the indices of the various elements in the array to slice it.

```
#!/usr/bin/env perl
my @array = (1..10);
my @newarray = @array[1,3,5,7]; # Slicing using indices.
```

30. **How will you get replace elements of an array**? Using *splice* keyword.

```
#!/usr/bin/perl

@array = (1..20);
print "Before - @array\n"; # Before - 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

splice(@nums, 5, 5, 21..25);
print "After - @nums\n"; # After - 1 2 3 4 5 21 22 23 24 25 11 12 13 14 15 16 17 18 19 20
```

31. **How will you convert a string to an array?** Using the split() subroutine one can convert strings to arrays using regular expression.

32. **How will convert an array to string?** The join() subroutine can be used to convert a array to a string.

33. **How will you sort an array?** The sort keyword is used to sort arrays

34. **What is the purpose of $[variable?** Used to set the start of the array to 1.

35. **How will you merge two array?** *push* subroutine will help in jioning two arrays.

36. **How will you create Hashes in perl?** Using % followed by a name of the variable then assign keys and value such the code snippet below.

```
#!/usr/bin/env perl

my %person1 = ('Name' => "Albert", 'Age' => 50); # This is a hash
```

37. **How will you get elements from Hashes in perl?** A scalar and reference to the key is used to access the element of a hash

```
#!/usr/bin/env perl
```

```
my %person1 = ('Name' => "Albert", 'Age' => 50); # This is an hash
print "$person{'Name'}\n"; # Accessing a value from the hash
```

38. **How will you get all the keys from Hashes in perl?** The *keys* keyword is used to access the keys from a hash.

```
#!/usr/bin/env perl

my %person1 = ('Name' => "Albert", 'Age' => 50); # This is an hash
@thekeys = keys %person1; # getting the keys
```

39. **How will you get all the values from Hashes in perl?** The *values* keyword is used to access the keys from a hash.

```
#!/usr/bin/env perl

my %person1 = ('Name' => "Albert", 'Age' => 50); # This is an hash
@thevalues = values %person1; # getting the keys
```

40. **How will you check if key exists in a hash or not?** Using conditional *if* one can check if a key exists in a hash.

41. **How will you get the size of hash?** The size of the hash can be obtained by changing the list context to scalar context.

42. **How will you add an element to a hash?** Assign a new key and value using the assignment operator will add a new element to the hash.

43. **How will you remove an element from a hash**? *delete* keyword is used here together with the scalar-key reference to remove an element from a hash.

44. **What is the purpose of the next statement?**

45. **What is the purpose of the last statement?** Loop is immediately terminated and the program control resumes at the next statement following the loop.

46. **What is the purpose of the continue statement?** The loop jumps to the next iteration.

47. **What is the purpose of the redo statement?** Restarts the loop block without evaluating the conditional again.

48. **What is the purpose of the goto Label statement?** It jumps to the statement labeled with LABEL and resumes normal execution from there.

49. **What is the purpose of the gote Expr statement?** It is a generalization of goto LABEL. The expression returns a label name

and then jumps to that labeled statement.

50. **What is the purpose of the goto &NAME statement?** For currently running subroutine it substitutes a call to the named subroutine.

51. ** is exponentiation. 2**2 will result to 4

52. <=> Numeric comparison, returning -1, 0, or 1

53. *lt* Less than

54. *gt* Greater than

55. *le* less than or equal.

56. *ge* greater than or equal.

57. *eq* For comparing string equality.

58. *ne* For comparing non equality of strings

59. *cmp* String comparison, returning -1, 0, or 1

60. **= The exponentiation assignment operator.

61. q{} Single Quotes, does not allow interpolation.

62. qq{} Double Quotes, allow interpolation.

63. qx{} Backquote, executes external command inside backquotes.

64. . (dot) Concatenation of two strings.

65. x Used for repetition.

66. .. (two dots) Used to depict range. (1..10) will result in numbers from 1 to 10.

67. ++ Increment of values

68. – decrement of values

69. -> Used in referencing

70. localtime() This subroutine returns values of current date and time. Converts a time as returned by the time function to a 9 -element list with the time analyzed for the local time zone

71. **What is the purpose of gmtime() function?** Converts a time as returned by the time function to an 9-element list with the time localized for the standard Greenwich time zone.

72. **What is the difference between localtime() and gmtime() functions?** *localtime()* returns the local time whereas *gmtime()* returns the time at the greenwich meridian.

73. **What is the purpose of time() function?** This function returns the number of seconds since the epoch (00:00:00 UTC, January 1, 1970, for most systems; 00:00:00, January 1, 1904, for Mac OS). Suitable for feeding to gmtime and localtime.

74. **What is the purpose of strftime() function?** formats the broken-down time tm according to the format specification format and places the result in the character array s of size max.

75. **How will you define a subroutine in perl?** The general form of a subroutine definition in Perl programming language is as follows -

```
sub subroutine_name{
   body of the subroutine
}
```

76. **How will you call a subroutine in perl?** The typical way of calling that Perl subroutine is as follows -

```
subroutine_name( list of arguments );
```

77. **How will you access the parameters passed to a perl subroutine?** they can be acessed inside the function using the special array @_. Thus the first argument to the function is in *$[0], the second is in $*[1], and so on.

78. **How will you get the count of parameters passed to a perl subroutine?** using *scalar(@_)*, we can get the total number of arguments passed.

79. **What is the purpose of my operator?** The my operator confines a variable to a particular region of code in which it can be used and accessed. Outside that region, this variable cannot be used or accessed.

80. **What is the default scope of perl variables?** By default, all variables in Perl are global variables, which means they can be accessed from anywhere in the program.

81. **What are lexical variables in perl?** Lexical variables are private variables created using my operator.

82. **What is purpose of local operator in perl?** The local is used when the current value of a variable must be visible to called subroutines.

83. **What is dynamic scoping?** A local just gives temporary values to global (meaning package) variables. This is known as dynamic scoping.

84. **What is lexical scoping?** Lexical scoping is done with my operator. A lexical scope is usually a block of code with a set of braces around it, such as those defining the body of the subroutine or those marking the code blocks of if, while, for, foreach, and eval statements. The my operator confines a variable to a particular region of code in which it can be used and accessed. Outside that region, this variable cannot be used or accessed.

85. **What are state variables in perl?** There are another type of lexical variables, which are similar to private variables but they maintain their state and they do not get reinitialized upon multiple calls of the subroutines. These variables are defined using the state operator and available starting from Perl 5.9.4.

86. **What is Subroutine Call Context?** The context of a subroutine or statement is defined as the type of return value that is expected. This allows you to use a single function that returns different values based on what the user is expecting to receive. For example, the following localtime() returns a string when it is called in scalar context, but it returns a list when it is called in list context.

`my $datestring = localtime( time );` In this example, the value of $timestr is now a string made up of the current date and time, for example, Thu Nov 30 15:21:33 2000. Conversely -

`($sec,$min,$hour,$mday,$mon, $year,$wday,$yday,$isdst) = localtime(time);` Now the individual variables contain the corresponding values returned by localtime() subroutine.

87. **What is a Perl references?** A Perl reference is a scalar data type that holds the location of another value which could be scalar, arrays, or hashes. Because of its scalar nature, a reference can be used anywhere, a scalar can be used.

88. **How will you create a reference for a variable?** You can create a reference for any variable by prefixing it with a backslash as follows -

```
$scalarref = \$foo;
```

89. **How will you create a reference for a array?** You can create a reference for any array by prefixing it with a backslash as follows -

```
$arrayref  = \@ARGV;
```

90. **How will you create a reference for a hash?** You can create a reference for any hash by prefixing it with a backslash as follows -

```
$hashref   = \%ENV;
```

91. **How will you create a reference for a subrouting?** You can create a reference for any subrouting by prefixing it with a backslash as follows -

```
$cref = \&PrintHash;
```

92. **What is dereferencing?** Dereferencing returns the value from a reference point to the location.

93. **How will you dereference a reference?** To dereference a reference simply use $, @ or % as prefix of the reference variable depending on whether the reference is pointing to a scalar, array, or hash.

94. **What is circular reference?** A circular reference occurs when two references contain a reference to each other. You have to be careful while creating references otherwise a circular reference can lead to memory leaks. Following is an example -

```
#!/usr/bin/perl
my $foo = 100;
$foo = \$foo;

print "Value of foo is : ", $$foo, "\n";
```

When above program is executed, it produces the following result -

Value of foo is : REF(0x9aae38)

95. **How will you open a file in read-only mode?**

Following is the syntax to open file.txt in read-only mode. Here less than < sign indicates that file has to be opend in read-only mode.

```
open(DATA, "<file.txt");
```

Here DATA is the file handle which will be used to read the file.

96. **How will you open a file in writing mode?** Following is the syntax to open file.txt in writing mode. Here less than > sign indicates that file has to be opend in the writing mode.

```
open(DATA, ">file.txt") or die "Couldn't open file
file.txt, $!";
```

97. How will you open a file in writing mode without truncating it? Following is the syntax to open file.txt in writing mode without truncating it. Here less than +< sign indicates that file has to be opend in the writing mode without truncating it.

```
open(DATA, "+<file.txt") or die "Couldn't open file
file.txt, $!";
```

98. What is the purpose of close() function? To close a filehandle, and therefore disassociate the filehandle from the corresponding file, you use the close function. This flushes the filehandle's buffers and closes the system's file descriptor.

99. What is the purpose of getc() function? The getc function returns a single character from the specified FILEHANDLE, or STDIN if none is specified.

100. What is the purpose of read() function?

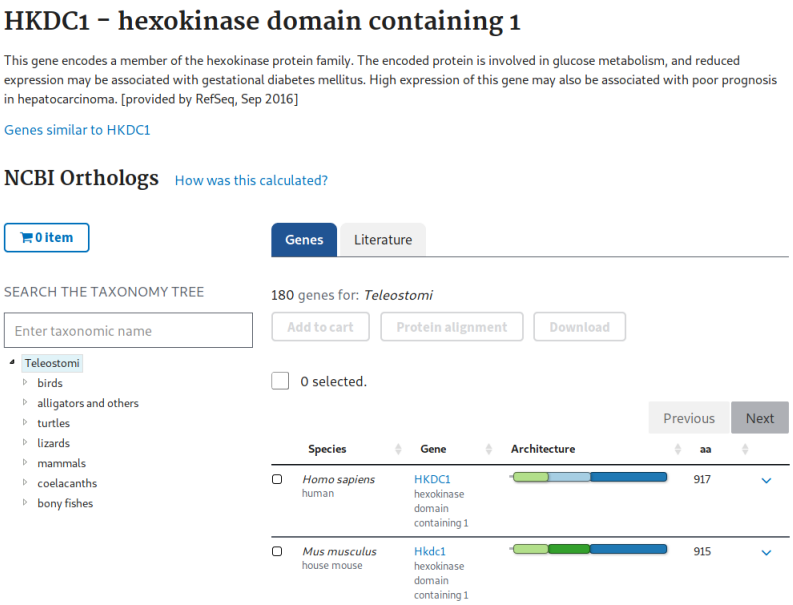
The read function reads a block of information from the buffered filehandle: This function is used to read binary data from the file.

SECTION 2

1. Look for the protein HKDC1

a. What is the function of this protein? **Catalyses the rate limiting of glucose metabolism.**

b. find the orthologs of the protein



c. Do a multiple sequence alignment of the protein with the orthologs to identify a non-conserved site

d. Using perl, write a script that gets out the non-conserved region and inserts a conserved sequence to make any of the 2 orthologs similar.

e. How is this similar to cloning?

ii. How can you apply this principle in real life?

2. Get the DNA sequence of human UCP2 gene. Write a perl script that:

a. Calculate the number of base pairs in the gene.

```
#!/usr/bin/env perl

$dna_filename = "sequence.txt";
chomp $dna_filename;
unless ( open(DNAFILE, $dna_filename) )
{
    print "Sorry the file does not exist!!! \n";
    print "Cannot open file \"$dna_filename\"\n";
    die;
}
@DNA = <DNAFILE>;
close DNAFILE;
$DNA = join( '', @DNA);
print " \n The original DNA file is:\n  $DNA \n";
$DNA =~ s/^>//g;
$DNA =~ s/^\s*#//g;
$DNA =~ s/\s//g;
@DNA = split( '', $DNA );
$count_of_A = 0;
$count_of_C = 0;
$count_of_G = 0;
$count_of_T = 0;
$errors     = 0;
foreach $base (@DNA) {
    if ( $base eq  'A' ) {
        ++$count_of_A;
    } elsif ( $base eq 'C' ) {
        ++$count_of_C;
    } elsif ( $base eq 'G' ) {
        ++$count_of_G;
    } elsif ( $base eq 'T' ) {
```

```
        ++$count_of_T;
    }
    else {
        print "Error - Unknown base: $base\n";
        ++$errors;
    }
}
print "Adenine = $count_of_A\n";
print "Cytosine = $count_of_C\n";
print "Guanine = $count_of_G\n";
print "Thymine = $count_of_T\n";

if ($errors) {
        print "There were $errors unrecognized bases.\n";
}
```

b. Cuts the sequence halfway to give 2 equal fragments

```
#!/usr/bin/env perl

$dna_filename = "sequence.txt";
chomp $dna_filename;
unless ( open(DNAFILE, $dna_filename) )
{
    print "Sorry the file does not exist!!! \n";
    print "Cannot open file \"$dna_filename\"\n";
    die;
}
@DNA = <DNAFILE>;
close DNAFILE;
$DNA = join( '', @DNA);
$DNA =~ s/\s//g;
$first_portion = length($DNA)/2;
print "$first_portion\n";
print length($DNA);
$DNA_first = substr $DNA, 0, $first_portion;
$DNA_last = substr $DNA, $first_portion, $first_portion;

print "$first_portion";
print "=========================  First Portion ====================";
print "$DNA_first\n\n";

print "========================== Last Portion ====================\n";
print "$DNA_last";
```

4. Is the sequence ACCTAGGT palindromic?

a. Justify your answer with the aid of a perl script.

b. Write pseudocode for the script in (a) above