

CS252 end sem exam

90 minutes

100 points

(closed book, closed notes, closed devices)

(UNIX scripting) 5 points

1. I have stored a comma-delimited string "abcabc,cabca,abe,eds,adte,ptras,bacsa" in the variable \$stringvar in my UNIX shell.

(a) How can I print out the fourth field from this variable in the shell? (2 points)

(b) In the above example, how could I print out each of the fields in the variable in a new line? (3 points)

(IP/Socket programming) 10 points

1. Which of these are not acceptable MAC addresses? If not, why not? (3 points)

(a) FF-FF-FF-FF-FF-FF

(b) AB-CD-EF-FE-DG-BA

(c) 00-00-00-00-00-00

(d) 28-03-2F-BC-35

2. When I run ifconfig on my machine, I see an IP address 172.27.15.79. When I use a third party IP lookup service, it gives me an IP address 202.3.77.205.

(a) Why is this happening? (2 points)

(b) Let's say a third party lookup shows my IP address as 198.23.132.6.12.43. What do you expect my ifconfig to show my IP address as? Why? (1 point)

3. Let's talk about sockets.

(a) I want to live stream my music performance to my friend using a socket connection. Should I use a TCP or a UDP connection? Why? (2 points)

(b) How does the client know what IP address and port of the server to address while trying to make a connection? How does the server know the client's IP address and port it must send data to during a connection, or during a connectionless request? (2 points)

(Web requests) 10 points

1. When a machine first connects to a network, it doesn't have an IP address. How does it acquire an IP address? (4 points)

2. In processing an HTTP request, what is the role of the DNS server? (2 points)

3. What will each of these network requests do? (4 points)

(a) ping www.google.com

(b) curl https://www.espnricinfo.com

(c) curl -O https://www.cse.iitk.ac.in/nsrivast/*.zip

(d) curl -I http://www.iitk.ac.in

(SQL/noSQL) 20 points

1. Give succinct answers to each of the following questions

(a) Why can't I just read and write data from a csv file? Why must I go to the trouble of setting up a database? (1 point)

Let's say I have an SQL table called *bookings* that has a column called *student_id*.

(b) What output will the SQL statement 'SELECT count(student_id) AS total ;' return? (1 point)

(c) If the table contains a total of 100 records, and the student with ID 23 has made 5 bookings, what will be the output of 'SELECT count(student_id) FROM orders WHERE student_id <> 23;' (1 point)

(d) I have a table *Employee* that stores employee *name*, *designation* and *salary* for my department. Use SQL to pull out the record of the employee with the fourth highest salary in my department. (3 points)

2. I have a table of *students* that lists their names, their ages, their courses this semester, each course's credit count, and the total credits they are registered for this semester. I want to stick this table into an SQL database.

Name	Age	Courses	Credits	Total
Radha	19	ESC101, PHY101, CHM101, TA101	13, 9, 9, 6	37
Krishna	23	CS698F, CS335, ENG112	9, 9, 9	27
Sita	21	CS252, CS210, CS771, CS300	6, 9, 9, 6	30
Ram	22	CS771, CS786, CS300, EE485	9,9,6,9	33
Laxmi	23	CS499, MSO209	9,9	18

- (a) Can you put this table into the first normal form? What is the value of doing this? (2 points)
- (b) Can you put this table into the second normal form? What is the value of doing this? (2 points)
- (c) Can you put this table into the third normal form? What is the value of doing this? (2 points)

3. Let's say I store the *students* table as a MongoDB collection instead.

(a) What are the advantages/disadvantages of doing this vis-à-vis using a relational database? (2 points)

(b) Write me a mongo statement that will insert one new record into *students*. To ensure a standard response, suppose the database name is *iitk*, the student's name is Vishnu, 22 years old, taking ESO207, MSO209 and ENG112, with 10, 9 and 9 credits respectively, totaling 28 credits. (1 point)

(c) Write me a mongo query that will return the records of students who are taking CS771 and are simultaneously taking more than 30 credits this semester (2.5 points)

(d) Write me a mongo query that will return me counts of registrations in individual courses from this table. (2.5 points)

(JS basics) 10 points

1. Debug the following code, meant to display a list of bike names and mileages assuming the object *Bike* contains multiple entries, each with two fields *name* and *Mileage* (3 points)

```
let displayMileage =>{
  Bike.forEach(function(){
    console.log('Mileage of ' + name + ' is ' + Mileage);
  })
}
displayMileage();
```

2. What will be the output of the following JS code? (2 points)

```
var arr = ['apple', 'banana', 'carrot'];
barr = arr.reverse();
arr.push('orange');
console.log(arr.reverse());
console.log(barr.reverse());
```

3. What will be the output of the following JS code? (3 points)

```
const showNumbers = () => {
  console.log('this');
  setTimeout( () => {console.log('is')}, 500);
  setTimeout( () => {console.log('not')}, 0);
  console.log('hard');
}
showNumbers();
```

4. What does the following code do? (2 points)

```
var http = require('http');
var count = 0;
http.createServer(function (req, res) {
  count++;
  res.writeHead(200, {'Content-Type': 'text/plain'});
  res.write('Hello ' + count);
  res.end();
}).listen(8080);
```

(JS Back-end) 15 points

Let's say I want to make a website that serves data from the *students* mongo collection we created above. Let's also say that I'm using Express to route my application. The directory structure of this app looks like the following

```
exam-app/
-- node_modules
-- models
-- routes
-- views
-- public
---- stylesheets
---- javascripts
---- images
app.js
package.json
```

1. Where would I put the following code?

(a) The HTML code constructing the webpage, giving options for selecting which data I want to look at (1 point)

(b) The JS code that controls display changes on the webpage (1 point)

(c) The JS code that controls what data is accessed from the mongo database given a particular data request (1 point)

(d) Code specifying what routes my application is using and where to look for them (1 point)

(e) Code specifying what node dependencies my application requires (1 point)

2. I want to give my users the ability to look up any individual student's course registration details by name, and the ability to look up any course's registration status by course ID. Can you generate a routing file that will give me these two functionalities? (6 points)

3. What are the components of an MVC architecture, and what are the interactions between these components? (4 points)

(JS Front-end) 10 points

1. I want you to make me a website that has a panel of five numbered buttons in a row, and clicking on any of the buttons should update a text field below this panel with the number of the button just clicked. (*note: syntax errors will not be penalized, but I want real code, not pseudocode*). (5 points)

2.

(a) In Angular, what is the difference between the *ng-model* and *ng-bind* directives? (2 points)

(b) Complete the Angular code block below to show the contents of the game inventory given below as an ordered list on the webpage (3 points)

```
<div ng-app="" ng-init="games = [{name: 'GTA5', cost: 400, qty: 5}, {name: 'Fortnite', cost: 800, qty: 2}, {name: 'Farmville', cost: 20, qty: 15}]">
<p> Game inventory: </p>
    // add code here
</div>
```

(Security) 10 points

1. What is an SQL injection attack? Can you give an example? How can we protect against it? (5 points)

2. I use the following login authentication protocol. I store my users' password in my database as part of their profile records. Then, when someone tries to login with a particular user name, I go look for the password stored for that username in my database. For efficiency, I then do something like

if length(actual pwd) <> length (entered pwd)

```
        return 'failed'
for iter in length(actual pwd)
    if actual pwd <> entered pwd
        return 'failed'
return 'success'
```

Someone tells me my system is susceptible to a timing attack. What could they possibly mean? How could I protect against such an attack? (5 points)

(Optimizing web services) 10 points

1. How does load balancing improve web service quality? (2 points)
2. What is the difference between running load-balanced replicas of my database and sharding it? (2 points)
3. What are CDNs, and how can they help improve web service quality? (2 points)
4. What is database caching and how it improve web service quality? (2 points)
5. What is Jevons' paradox, and how does it apply to web service design? (2 points)