VT Course Insights

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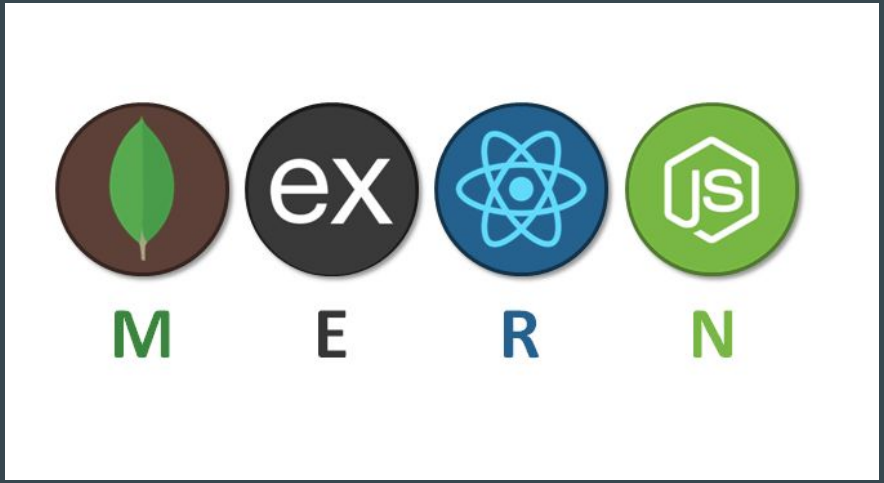
https://github.com/uehlingeric/VTCourseInsights

What is VT Course Insights?

- Target Users: Virginia Tech students planning course enrollments
- Purpose: Facilitating informed decision-making in course selection
- Data Access: Historical data on departments, courses, and instructors
- Time Span: Comprehensive data coverage from 2018 to 2023
- Key Features:
  - GPA Trends Analysis: Insight into academic performance over time
  - Enrollment Numbers: Understanding course popularity and availability
  - Withdrawal Rates: Gauging course difficulty and student satisfaction
- Objective: Simplifying course selection with a data-driven approach
- User Benefits: Tailored course planning aligned with academic goals

Our Tech Stack:



MongoDB:

- NoSQL Database
- Stores application data with flexibility in data structure. Allows for efficient data retrieval and management.

Express.js:

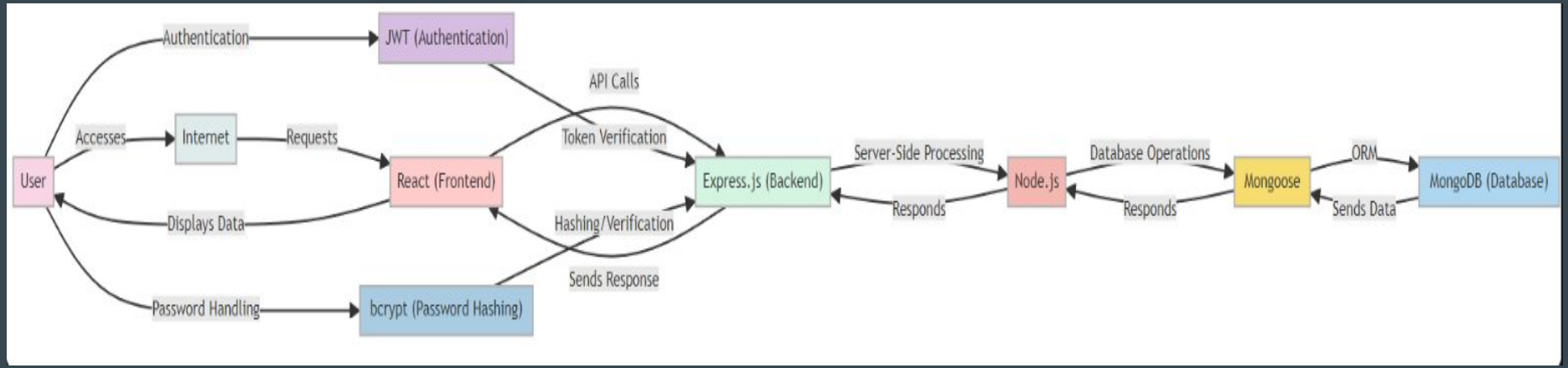
- Web Application Framework for Node.js
- Simplifies the creation of server-side logic and routes. Manages interactions between the frontend and the database.

React:

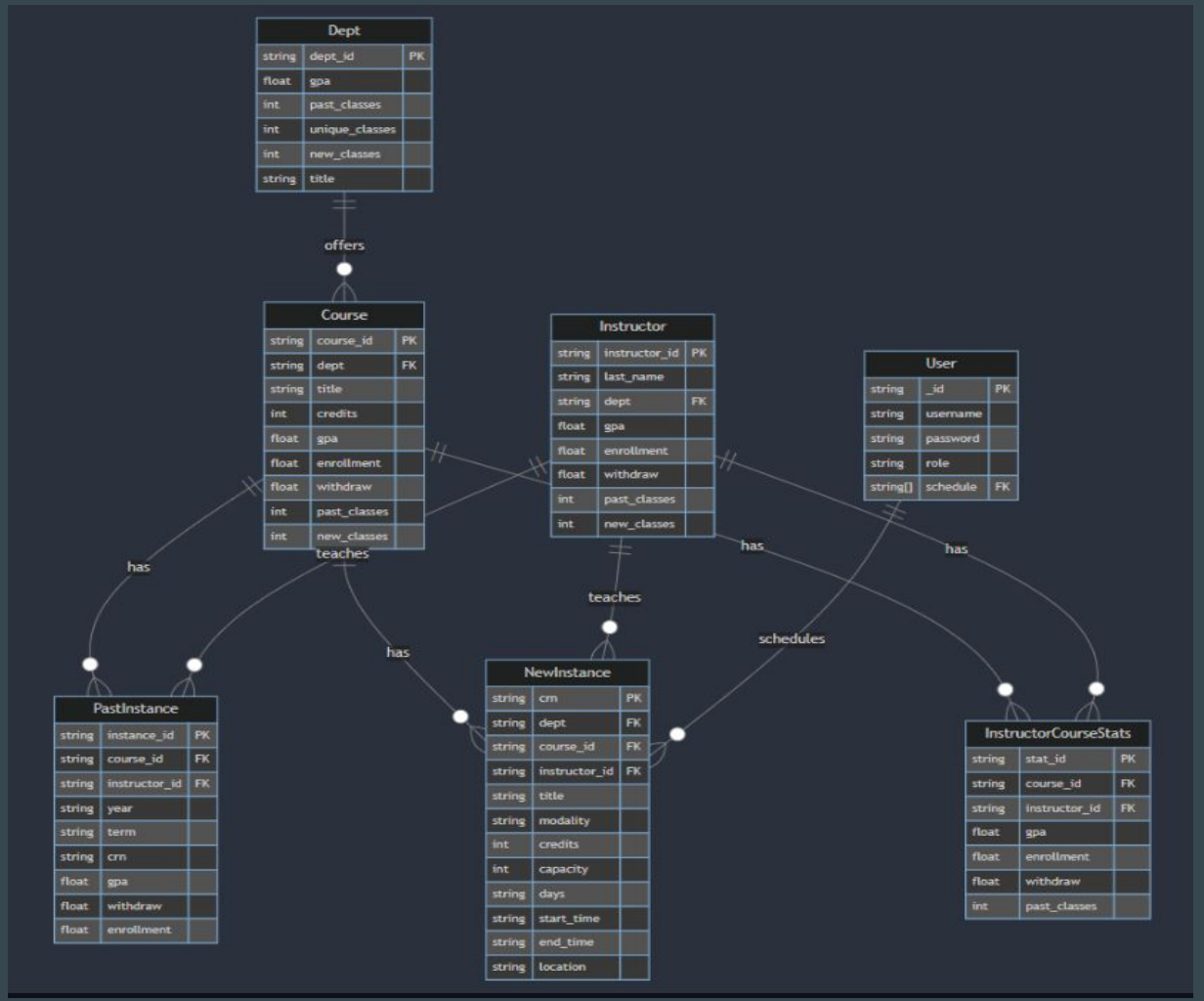
- JavaScript Library for Building User Interfaces
- Enables the creation of dynamic and responsive user interfaces. Simplifies the development of single-page applications.

Node.js:

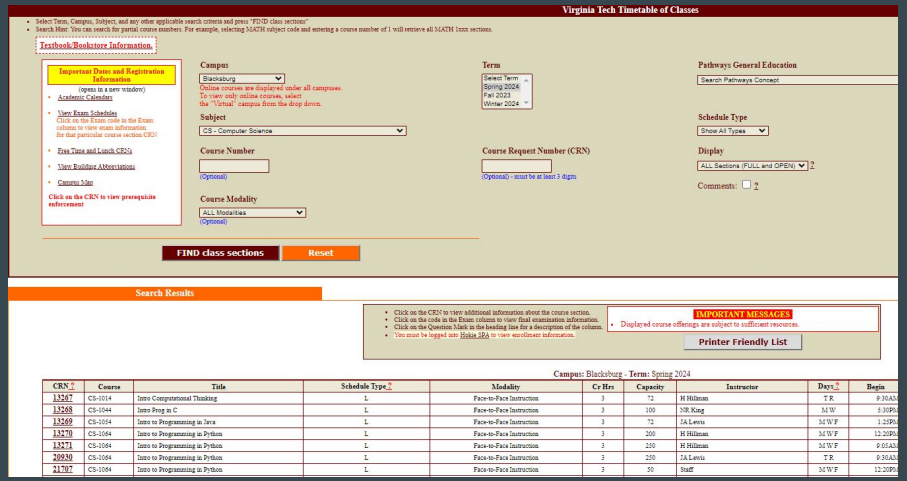
- JavaScript Runtime Environment
- Allows for the execution of JavaScript code on the server side. Powers the backend of the application with high performance and scalability.


User
Authentication
JWT (Authentication)
Accesses
Internet
Requests
React (Frontend)
Displays Data
API Calls
Token Verification
Express.js (Backend)
Server-Side Processing
Responds
Node.js
Database Operations
Responds
Mongoose
ORM
Sends Data
MongoDB (Database)
Hashing/Verification
Sends Response
Password Handling
bcrypt (Password Hashing)

Database Schema:



Web Scraping: Storing Offered Classes



scripts > raw_data > offered_raw.csv

```
crn,course,title,schedule_type,modality,cr_hrs,capacity,instructor,days,start_time,end_time,location,exam
10058,AAD-1214,Acting Locally,L,Face-to-Face Instruction,2,48,GW Hamming,M W,2:30PM,3:20PM,WLH 345,14M
20556,AAD-1214,Acting Locally,L,Face-to-Face Instruction,2,48,GW Hamming,M W,1:25PM,2:15PM,WLH 345,13M
21223,AAD-4234,Capstone Collaborations,L,Face-to-Face Instruction,3,10,BR Kirkland,W,9:30AM,12:00PM,BURCH 021,09W
10059,AAEC-1005,Econ Food Fiber Sys,L,Face-to-Face Instruction,3,70,PW Vertino de Queiroz,M W F,1:25PM,2:15PM,SEITZ 300,13M
10060,AAEC-1005,Econ Food Fiber Sys,L,Face-to-Face Instruction,3,302,SK Stephenson,M W F,12:20PM,1:10PM,SQUIR COLNL,12M
10061,AAEC-1006,Econ Food Fiber Syst,L,Face-to-Face Instruction,3,70,N Abedin,M W F,10:10AM,11:00AM,SEITZ 300,10M
10062,AAEC-1006,Econ Food Fiber Syst,L,Face-to-Face Instruction,3,621,MJ Ellerbrock,M W F,9:05AM,9:55AM,SQUIR COLNL,09M
10063,AAEC-2104,Personal Financial Planning,L,Face-to-Face Instruction,3,621,WA White,M W F,11:15AM,12:05PM,SQUIR COLNL,11M
10064,AAEC-2434,Foundations of Agribusiness,L,Face-to-Face Instruction,3,129,P Morelli Mercadante,M W F,1:25PM,2:15PM,SMYTH 146,13M
10065,AAEC-2974,Independent Study,I,,1 TO 19,0,Staff,(ARR),----- (ARR) -----,TBA,00X,
10066,AAEC-3004,Agr Prod & Cons Econ,L,Face-to-Face Instruction,3,48,C Wang,T R,2:00PM,3:15PM,FRALN 002,14T
10067,AAEC-3014,Analytic Methods Applied Econ,L,Face-to-Face Instruction,3,72,Z Chen,M W,4:00PM,5:15PM,WHIT 300,16M
10068,AAEC-3024,Monetary Glob Iss Applied Econ,L,Face-to-Face Instruction,3,72,YE Karagulle,M W F,1:25PM,2:15PM,NCB 270,13M
10069,AAEC-3204,Intl Agri Dvlp & Trad,L,Face-to-Face Instruction,3,48,C Larochelle,T R,11:00AM,12:15PM,MCB 209,11T
10070,AAEC-3314,Environmental Law,L,Face-to-Face Instruction,3,143,J Friedel,T R,11:00AM,12:15PM,NCB 160,11T
10071,AAEC-3324,Environment Sustain Dev Econ,L,Face-to-Face Instruction,3,152,MJ Ellerbrock,M W F,12:20PM,1:10PM,NCB 260,12M
10072,AAEC-3424,Value-Based Mgmt in AgBusiness,L,Face-to-Face Instruction,3,64,PW Vertino de Queiroz,T R,12:30PM,1:45PM,LITRV 1860,12T
21227,AAEC-3424,Value-Based Mgmt in AgBusiness,L,Face-to-Face Instruction,3,0,PW Vertino de Queiroz,M W F,10:10AM,11:00AM,FRALN 002,10M
10073,AAEC-3454,Small Bus Mgt and Ent,L,Face-to-Face Instruction,3,64,C Wang,T R,9:30AM,10:45AM,LITRV 1860,09T
```

Data Cleaning: Standardizing our Schema

scripts > raw_data > distribution.csv

```
"Academic Year","Term","Subject","Course No.","Course Title","Instructor","GPA","A (%)","A- (%)","B+ (%)","B (%)","B- (%)","C+ (%)","C (%)","C- (%)","D+
"2018-19","Fall","AOE","4254","Ocean Engineering Laboratory","Alexander","3.34","40","20","20","0","0","0","0","20","0","0","0","0","0","5","80350","
"2018-19","Fall","BMVS","6094","Board Certification Topics","Rossmeisl","3.74","40","40","20","0","0","0","0","0","0","0","0","0","0","5","81619","  1"
"2018-19","Fall","EDCI","5844","STEM Education Seminar","Wells","4","100","0","0","0","0","0","0","0","0","0","0","0","0","5","83585","  1"
"2018-19","Fall","EDCI","5844","STEM Education Seminar","Wells","4","100","0","0","0","0","0","0","0","0","0","0","0","0","5","83586","  1"
"2018-19","Fall","ESM","3064","Mech Behavior Matls Lab","Aidi","3.6","60","0","0","40","0","0","0","0","0","0","0","0","0","5","84308","  1"
"2018-19","Fall","FREC","3454","Trees in Built Environment Lab","Wiseman","3.2","0","20","20","60","0","0","0","0","0","0","0","0","0","5","84615","  1"
"2018-19","Fall","MUS","2244","TS:Flute","Lantz Crone","4","100","0","0","0","0","0","0","0","0","0","0","0","1","5","86732","  1"
"2018-19","Fall","MUS","2514","Individual Applied Voice","Cowan","3.8","60","20","20","0","0","0","0","0","0","0","0","0","0","5","86740","  1"
"2018-19","Fall","MUS","2634","Individual Applied Horn","Easter","3","20","0","20","40","0","0","0","20","0","0","0","0","0","5","86755","  1"
```

scripts > cleaned_data > past_instance.csv

```
instance_id,course_id,instructor_id,year,term,crn,gpa,withdraw,enrollment
2018-19Fall80350,AOE 4254,Alexander (AOE),2018-19,Fall,80350,3.34,0,5
2018-19Fall81619,BMVS 6094,Rossmeisl (BMVS),2018-19,Fall,81619,3.74,0,5
2018-19Fall83585,EDCI 5844,Wells (EDCI),2018-19,Fall,83585,4.0,0,5
2018-19Fall83586,EDCI 5844,Wells (EDCI),2018-19,Fall,83586,4.0,0,5
2018-19Fall84308,ESM 3064,Aidi (ESM),2018-19,Fall,84308,3.6,0,5
2018-19Fall84615,FREC 3454,Wiseman (FREC),2018-19,Fall,84615,3.2,0,5
2018-19Fall86732,MUS 2244,Lantz Crone (MUS),2018-19,Fall,86732,4.0,1,5
2018-19Fall86740,MUS 2514,Cowan (MUS),2018-19,Fall,86740,3.8,0,5
2018-19Fall86755,MUS 2634,Easter (MUS),2018-19,Fall,86755,3.0,0,5
```

User Authentication

Registration

- Endpoint: /api/user/register
- Method: POST
- Payload: { username: String, password: String }
- Description: New users can register by providing a unique username and a password. The password is hashed before being stored in the database for security.

Create Admin (Admin only)

- Endpoint: /api/user/createAdmin
- Method: POST
- Headers: { Authorization: Bearer Token }
- Payload: { username: String, password: String }
- Description: This endpoint is restricted to admin users. It allows an admin to create a new admin account by providing a username and password.

Login

- Endpoint: /api/user/login
- Method: POST
- Payload: { username: String, password: String }
- Description: Registered users can log in using their username and password. Upon successful login, a JSON Web Token (JWT) is generated and returned to the user. This token is used for subsequent requests to authenticate the user.

Change Password

- Endpoint: /api/user/changePassword
- Method: POST
- Headers: { Authorization: Bearer Token }
- Payload: { oldPassword: String, newPassword: String }
- Description: Allows authenticated users to change their password. Users must provide their old password for verification and a new password.

Overview of JWT and bcrypt

JWT (JSON Web Tokens): JWTs are used to securely transmit information between parties as a JSON object. In this project, JWTs are used to manage user sessions after authentication. When a user logs in, they receive a token that is used to authenticate subsequent HTTP requests to the server. This token ensures that the requests are made by an authenticated user.

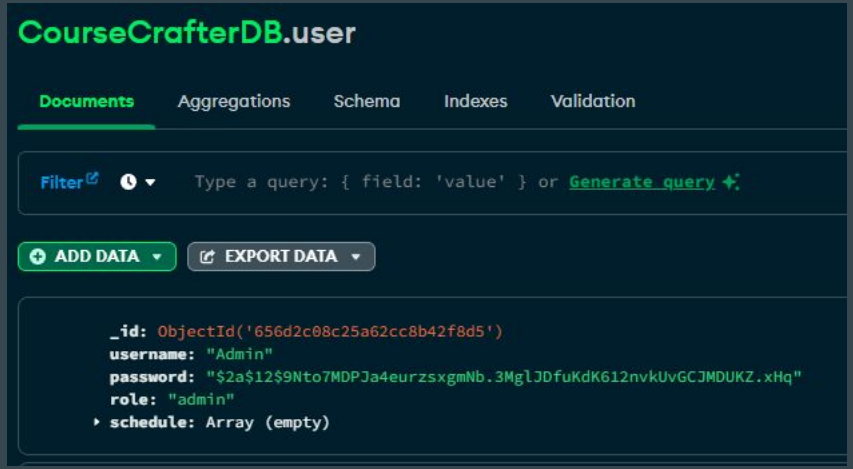
bcrypt: bcrypt is a password-hashing function. In this project, bcrypt is used to hash user passwords before they are stored in the database. When a user logs in, bcrypt is used again to compare the hashed version of the entered password with the hash stored in the database. This approach enhances security by ensuring that actual passwords are not stored in the database.

Bcrypt Password Hashing

“Password123” → "$2a$12$9Nto7MDPJa4eurzsxgmNb.3MglJDfuKdK612nvkUvGCJMDUKZ.xHq"

models > JS User.js > [@] <unknown>

```
1   const mongoose = require('mongoose');
2   const bcrypt = require('bcryptjs');
3
4   const userSchema = new mongoose.Schema({
5       username: { type: String, required: true, unique: true },
6       password: { type: String, required: true },
7       role: { type: String, default: 'user' }, // 'admin' for admin users
8       schedule: [{ type: String }]
9   });
10
11  // Hash password before saving
12  userSchema.pre('save', async function(next) {
13      if (!this.isModified('password')) return next();
14      this.password = await bcrypt.hash(this.password, 12);
15      next();
16  });
17
18  module.exports = mongoose.model('User', userSchema, 'user');
19
```



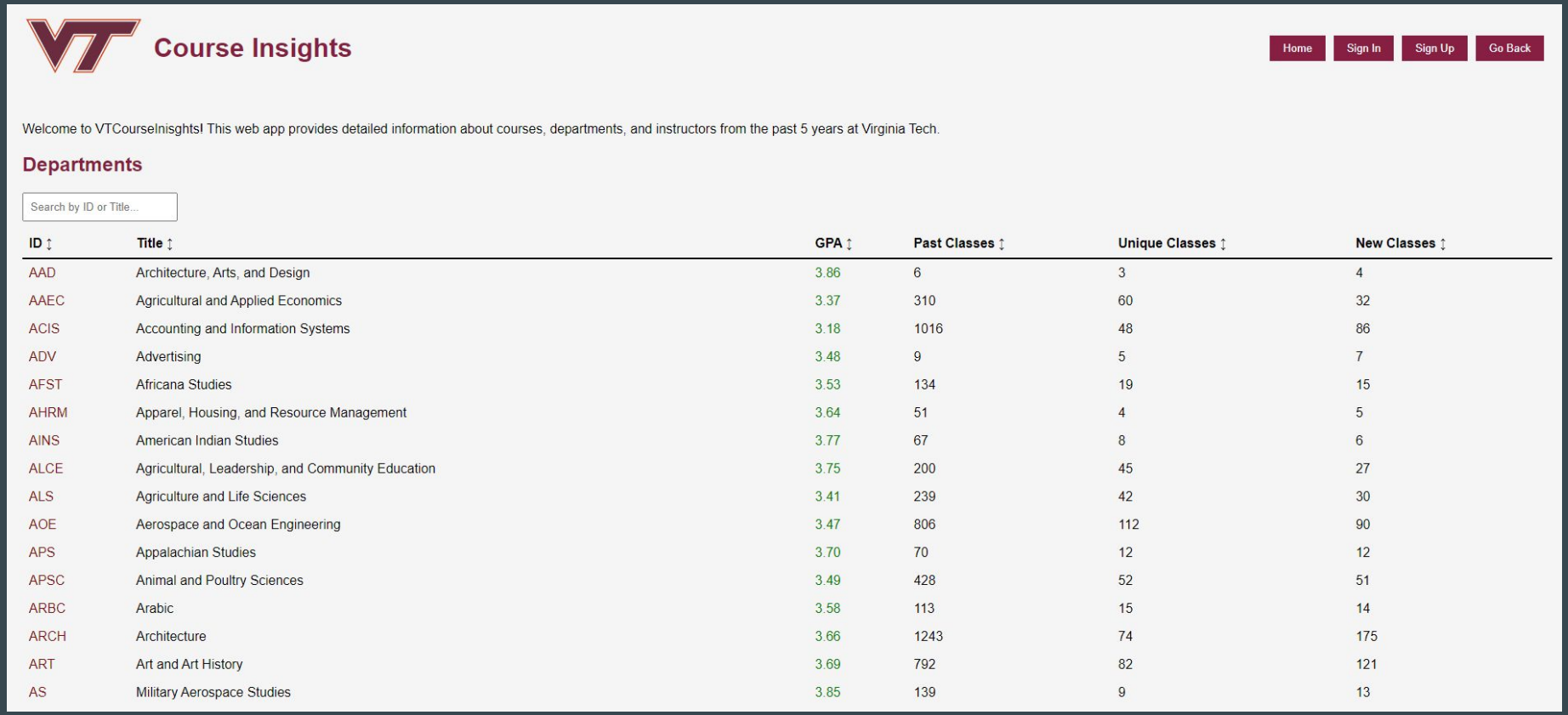
JWT: Middleware Authorization

```
/**
 * Middleware to protect routes by verifying the JWT token.
 * This ensures that the route is accessed by an authenticated user.
 */
const protect = async (req, res, next) => {
    let token;

    // Check if the authorization header is present and starts with 'Bearer'
    if (req.headers.authorization && req.headers.authorization.startsWith('Bearer')) {
        try {
            // Extract the token from the authorization header
            token = req.headers.authorization.split(' ')[1];

            // Verify the token using jwt.verify and the secret from environment variables
            const decoded = jwt.verify(token, process.env.JWT_SECRET);

            // Find the user based on the ID in the decoded token and attach the user object to the request
            // Exclude the password when attaching th
            req.user = await User.findById(decoded.id

            // Proceed to the next middleware
            next();
        } catch (error) {
            // If token verification fails, send a 40
            res.status(401).json({ message: 'Not auth
        }
    } else {
        // If no token is provided in the headers, se
        res.status(401).json({ message: 'Not authoriz
    }
};
```

```
/**
 * Middleware to check if the authenticated user is an admin.
 * This is used to protect routes that should only be accessible by admin users.
 */
const admin = (req, res, next) => {
    // Check if the user exists and has the role 'admin'
    if (req.user && req.user.role === 'admin') {
        // Proceed to the next middleware
        next();
    } else {
        // If the user is not an admin, send a 401 Unauthorized response
        res.status(401).json({ message: 'Not authorized as an admin' });
    }
};
```

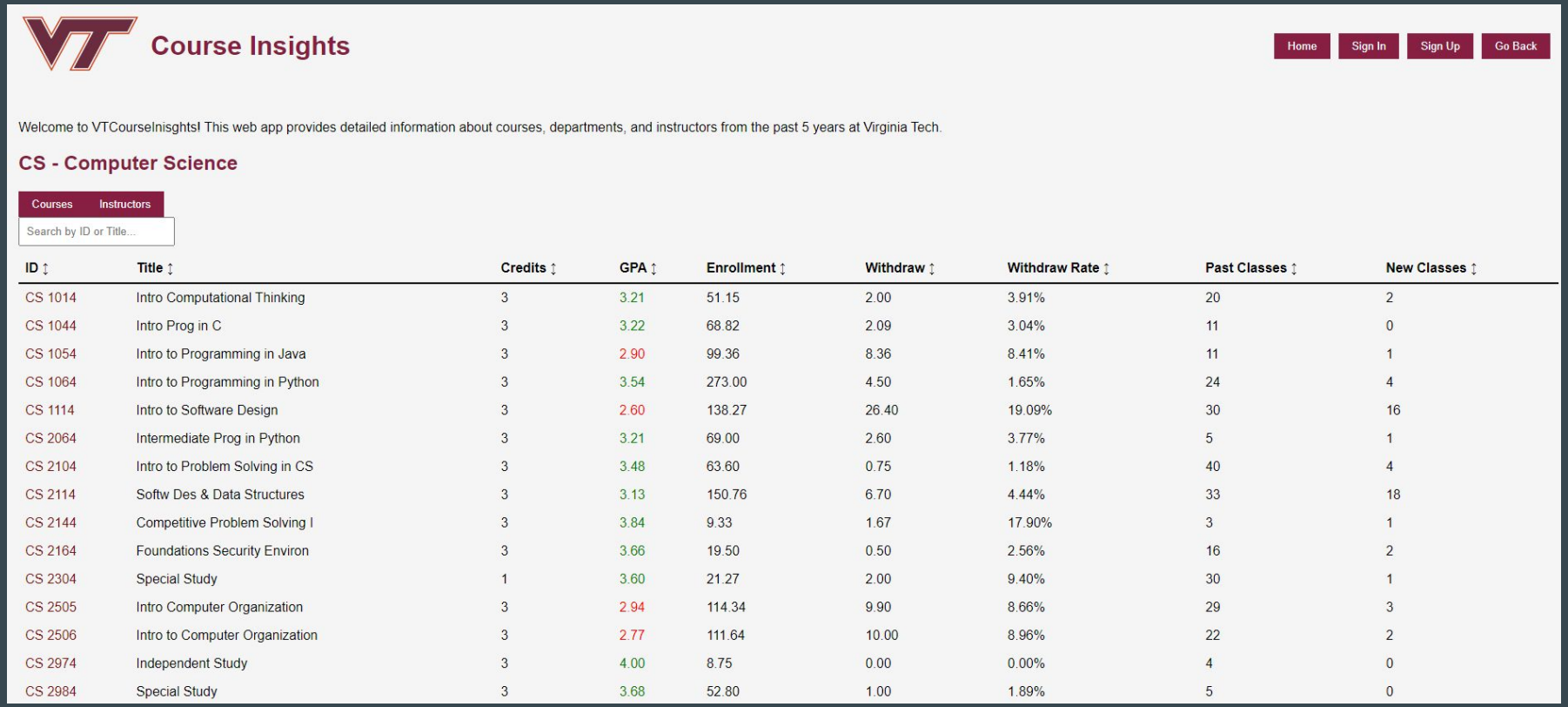
Site Functionality

Department List (Home)



ID ↕	Title ↕	GPA ↕	Past Classes ↕	Unique Classes ↕	New Classes ↕
AAD	Architecture, Arts, and Design	3.86	6	3	4
AAEC	Agricultural and Applied Economics	3.37	310	60	32
ACIS	Accounting and Information Systems	3.18	1016	48	86
ADV	Advertising	3.48	9	5	7
AFST	Africana Studies	3.53	134	19	15
AHRM	Apparel, Housing, and Resource Management	3.64	51	4	5
AINS	American Indian Studies	3.77	67	8	6
ALCE	Agricultural, Leadership, and Community Education	3.75	200	45	27
ALS	Agriculture and Life Sciences	3.41	239	42	30
AOE	Aerospace and Ocean Engineering	3.47	806	112	90
APS	Appalachian Studies	3.70	70	12	12
APSC	Animal and Poultry Sciences	3.49	428	52	51
ARBC	Arabic	3.58	113	15	14
ARCH	Architecture	3.66	1243	74	175
ART	Art and Art History	3.69	792	82	121
AS	Military Aerospace Studies	3.85	139	9	13

Department Detail - Courses Tab



Course Insights

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Welcome to VTCourseInsights! This web app provides detailed information about courses, departments, and instructors from the past 5 years at Virginia Tech.

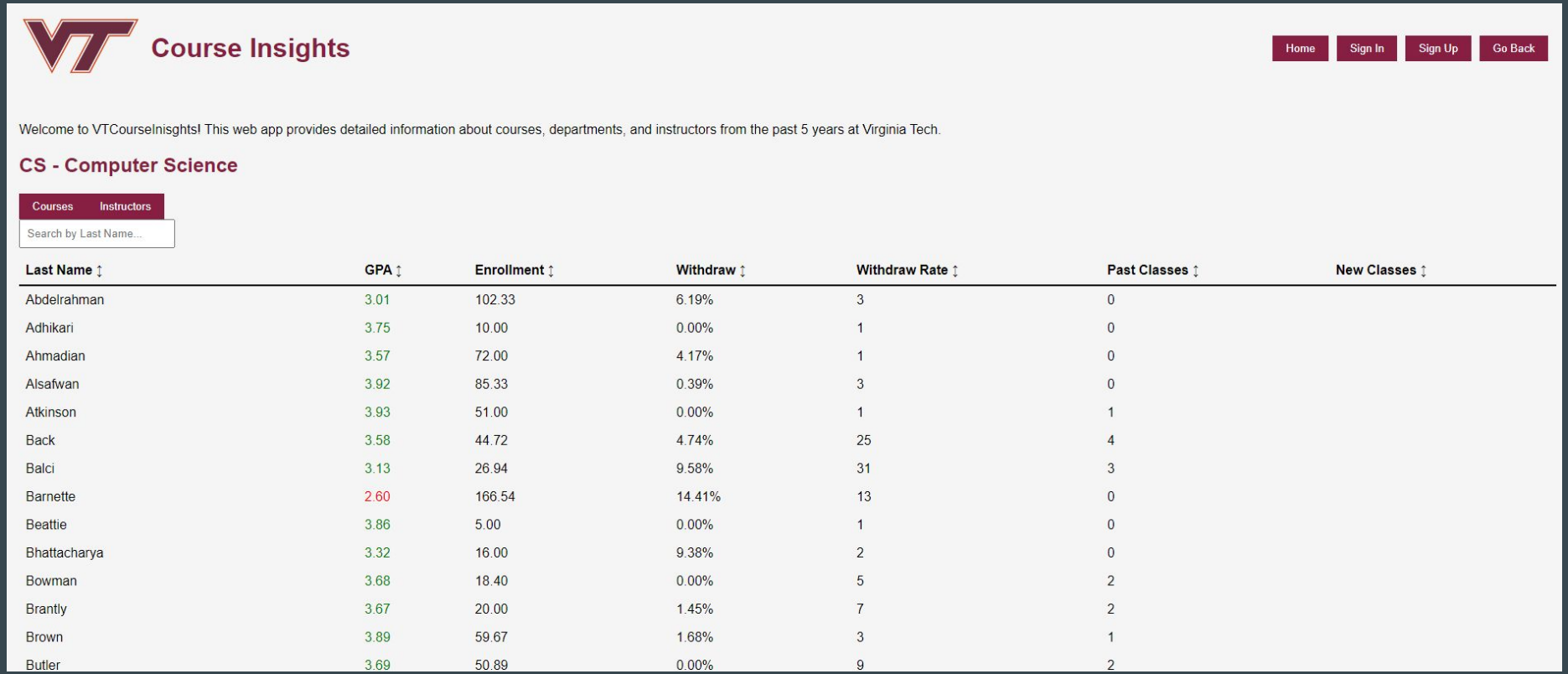
CS - Computer Science

Courses | Instructors

Search by ID or Title...

ID ↕	Title ↕	Credits ↕	GPA ↕	Enrollment ↕	Withdraw ↕	Withdraw Rate ↕	Past Classes ↕	New Classes ↕
CS 1014	Intro Computational Thinking	3	3.21	51.15	2.00	3.91%	20	2
CS 1044	Intro Prog in C	3	3.22	68.82	2.09	3.04%	11	0
CS 1054	Intro to Programming in Java	3	2.90	99.36	8.36	8.41%	11	1
CS 1064	Intro to Programming in Python	3	3.54	273.00	4.50	1.65%	24	4
CS 1114	Intro to Software Design	3	2.60	138.27	26.40	19.09%	30	16
CS 2064	Intermediate Prog in Python	3	3.21	69.00	2.60	3.77%	5	1
CS 2104	Intro to Problem Solving in CS	3	3.48	63.60	0.75	1.18%	40	4
CS 2114	Softw Des & Data Structures	3	3.13	150.76	6.70	4.44%	33	18
CS 2144	Competitive Problem Solving I	3	3.84	9.33	1.67	17.90%	3	1
CS 2164	Foundations Security Environ	3	3.66	19.50	0.50	2.56%	16	2
CS 2304	Special Study	1	3.60	21.27	2.00	9.40%	30	1
CS 2505	Intro Computer Organization	3	2.94	114.34	9.90	8.66%	29	3
CS 2506	Intro to Computer Organization	3	2.77	111.64	10.00	8.96%	22	2
CS 2974	Independent Study	3	4.00	8.75	0.00	0.00%	4	0
CS 2984	Special Study	3	3.68	52.80	1.00	1.89%	5	0

Department Detail - Instructors Tab



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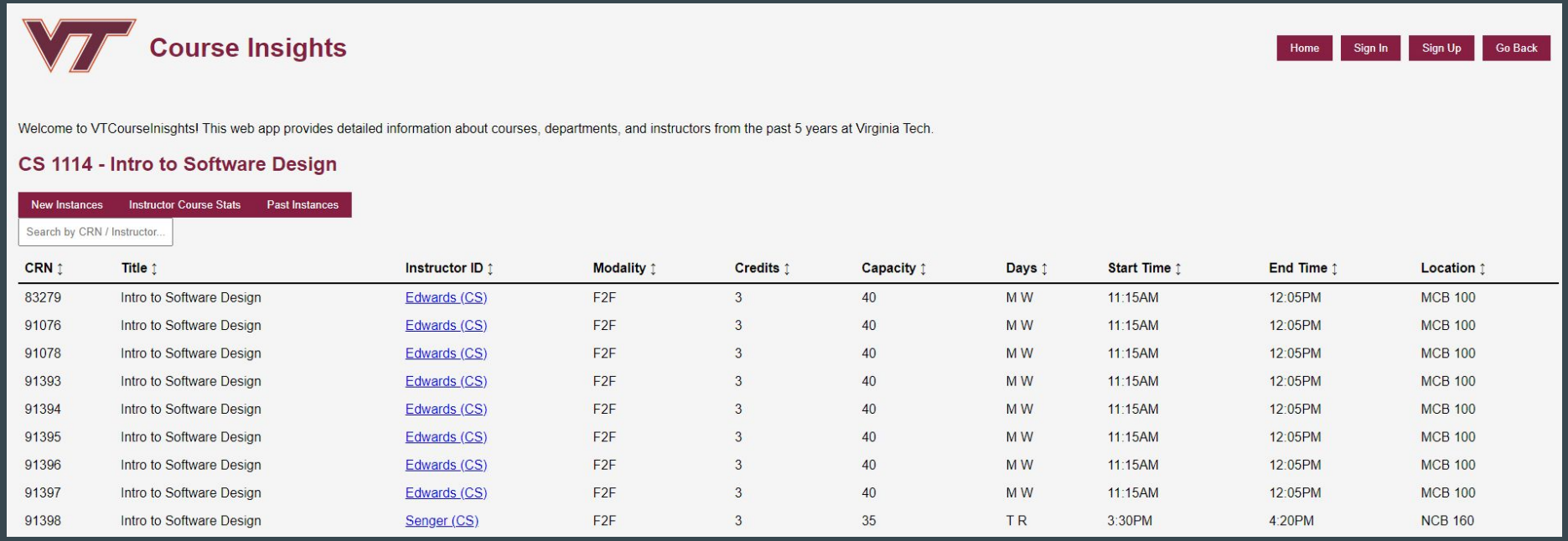
CS - Computer Science

Courses | Instructors

Search by Last Name...

Last Name ↕	GPA ↕	Enrollment ↕	Withdraw ↕	Withdraw Rate ↕	Past Classes ↕	New Classes ↕
Abdelrahman	3.01	102.33	6.19%	3	0	
Adhikari	3.75	10.00	0.00%	1	0	
Ahmadian	3.57	72.00	4.17%	1	0	
Alsafwan	3.92	85.33	0.39%	3	0	
Atkinson	3.93	51.00	0.00%	1	1	
Back	3.58	44.72	4.74%	25	4	
Balci	3.13	26.94	9.58%	31	3	
Barnette	2.60	166.54	14.41%	13	0	
Beattie	3.86	5.00	0.00%	1	0	
Bhattacharya	3.32	16.00	9.38%	2	0	
Bowman	3.68	18.40	0.00%	5	2	
Brantly	3.67	20.00	1.45%	7	2	
Brown	3.89	59.67	1.68%	3	1	
Butler	3.69	50.89	0.00%	9	2	

Course Detail - New Instances Tab



Course Insights

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Welcome to VTCourseInisghts! This web app provides detailed information about courses, departments, and instructors from the past 5 years at Virginia Tech.

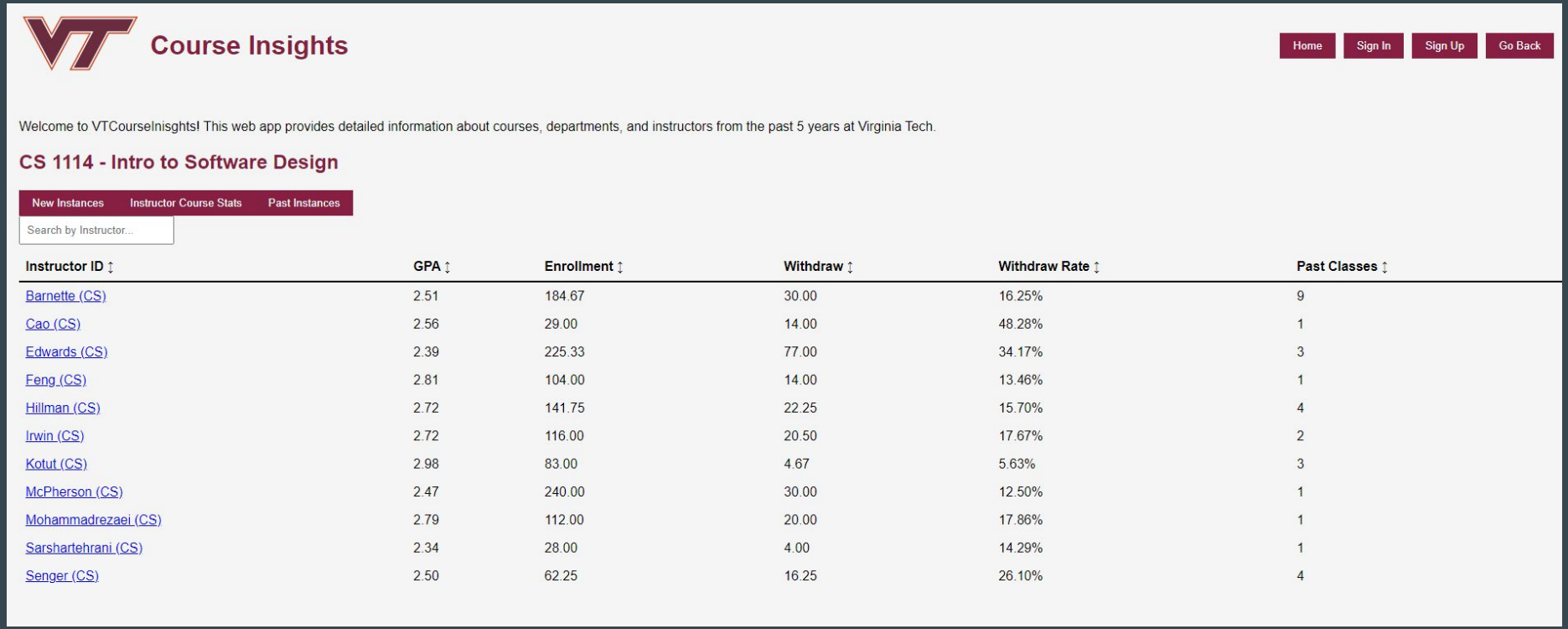
CS 1114 - Intro to Software Design

New Instances | Instructor Course Stats | Past Instances

Search by CRN / Instructor...

CRN ↕	Title ↕	Instructor ID ↕	Modality ↕	Credits ↕	Capacity ↕	Days ↕	Start Time ↕	End Time ↕	Location ↕
83279	Intro to Software Design	Edwards (CS)	F2F	3	40	M W	11:15AM	12:05PM	MCB 100
91076	Intro to Software Design	Edwards (CS)	F2F	3	40	M W	11:15AM	12:05PM	MCB 100
91078	Intro to Software Design	Edwards (CS)	F2F	3	40	M W	11:15AM	12:05PM	MCB 100
91393	Intro to Software Design	Edwards (CS)	F2F	3	40	M W	11:15AM	12:05PM	MCB 100
91394	Intro to Software Design	Edwards (CS)	F2F	3	40	M W	11:15AM	12:05PM	MCB 100
91395	Intro to Software Design	Edwards (CS)	F2F	3	40	M W	11:15AM	12:05PM	MCB 100
91396	Intro to Software Design	Edwards (CS)	F2F	3	40	M W	11:15AM	12:05PM	MCB 100
91397	Intro to Software Design	Edwards (CS)	F2F	3	40	M W	11:15AM	12:05PM	MCB 100
91398	Intro to Software Design	Senger (CS)	F2F	3	35	T R	3:30PM	4:20PM	NCB 160

Course Detail - Instructor Course Stats Tab



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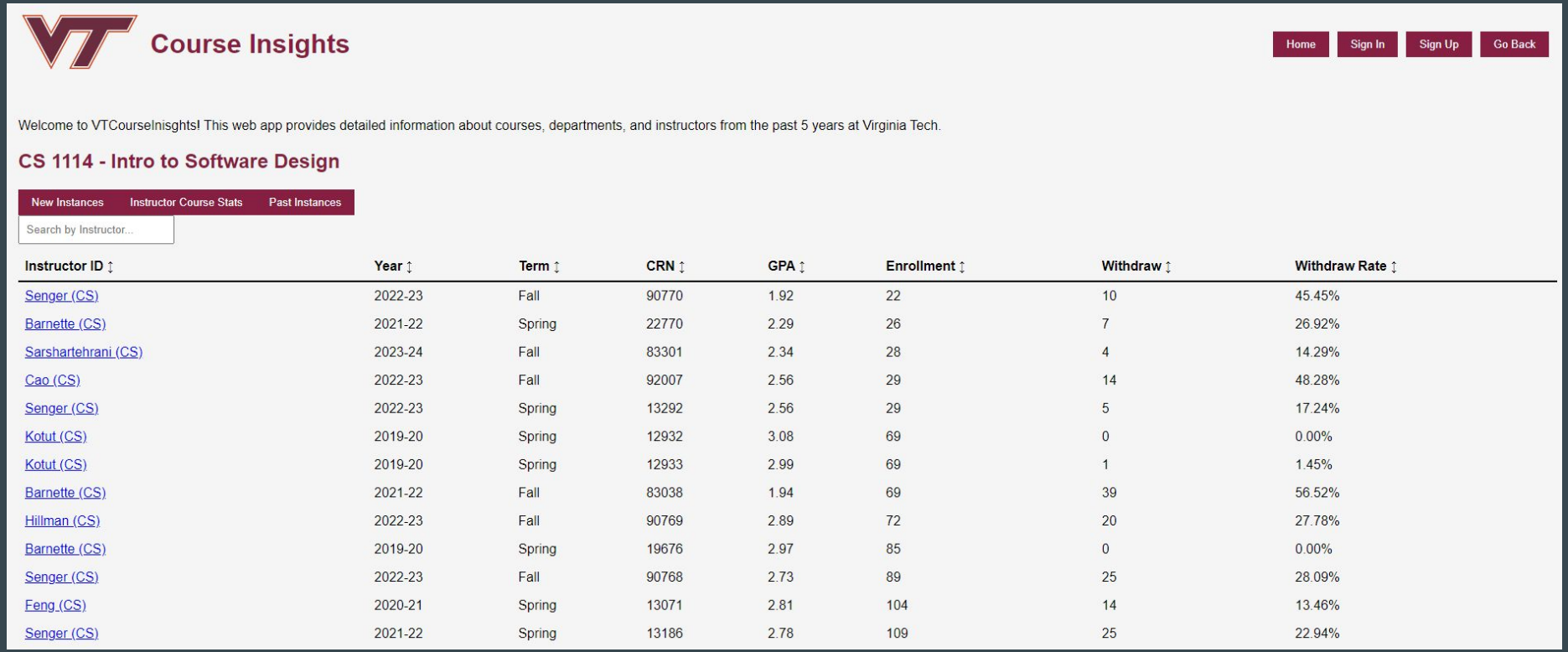
CS 1114 - Intro to Software Design

New Instances | Instructor Course Stats | Past Instances

Search by Instructor...

Instructor ID ↕	GPA ↕	Enrollment ↕	Withdraw ↕	Withdraw Rate ↕	Past Classes ↕
Barnette (CS)	2.51	184.67	30.00	16.25%	9
Cao (CS)	2.56	29.00	14.00	48.28%	1
Edwards (CS)	2.39	225.33	77.00	34.17%	3
Feng (CS)	2.81	104.00	14.00	13.46%	1
Hillman (CS)	2.72	141.75	22.25	15.70%	4
Irwin (CS)	2.72	116.00	20.50	17.67%	2
Kotut (CS)	2.98	83.00	4.67	5.63%	3
McPherson (CS)	2.47	240.00	30.00	12.50%	1
Mohammadrezaei (CS)	2.79	112.00	20.00	17.86%	1
Sarshartehrani (CS)	2.34	28.00	4.00	14.29%	1
Senger (CS)	2.50	62.25	16.25	26.10%	4

Course Detail - Past Instances Tab



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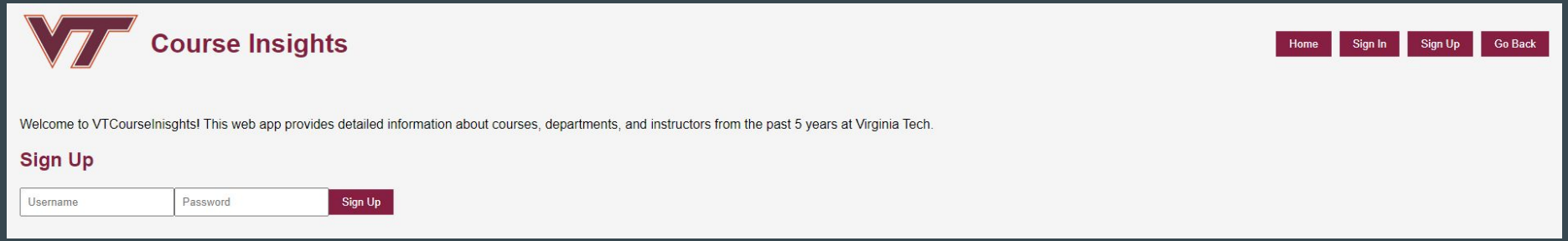
CS 1114 - Intro to Software Design

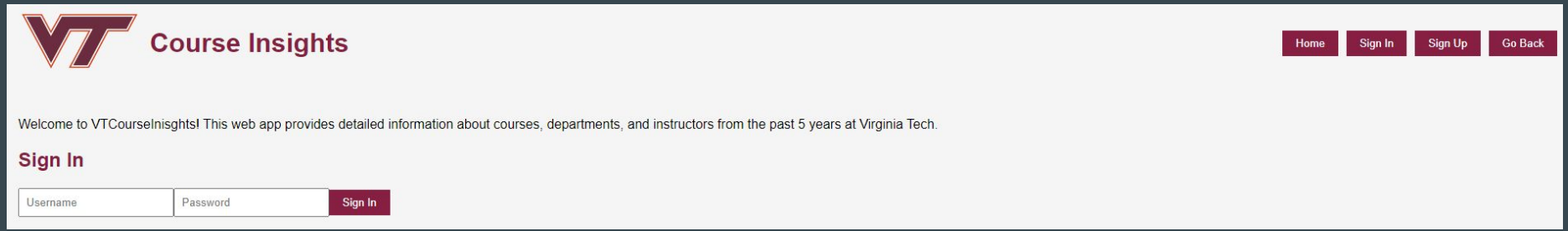
New Instances | Instructor Course Stats | Past Instances

Search by Instructor...

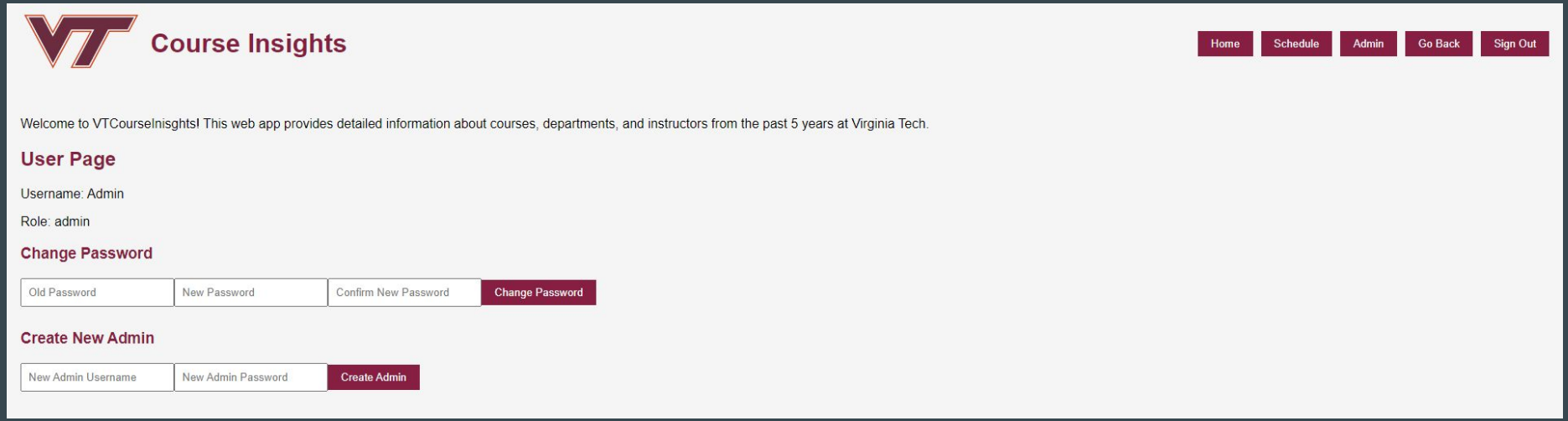
Instructor ID	Year	Term	CRN	GPA	Enrollment	Withdraw	Withdraw Rate
Senger (CS)	2022-23	Fall	90770	1.92	22	10	45.45%
Barnette (CS)	2021-22	Spring	22770	2.29	26	7	26.92%
Sarshartehrani (CS)	2023-24	Fall	83301	2.34	28	4	14.29%
Cao (CS)	2022-23	Fall	92007	2.56	29	14	48.28%
Senger (CS)	2022-23	Spring	13292	2.56	29	5	17.24%
Kotut (CS)	2019-20	Spring	12932	3.08	69	0	0.00%
Kotut (CS)	2019-20	Spring	12933	2.99	69	1	1.45%
Barnette (CS)	2021-22	Fall	83038	1.94	69	39	56.52%
Hillman (CS)	2022-23	Fall	90769	2.89	72	20	27.78%
Barnette (CS)	2019-20	Spring	19676	2.97	85	0	0.00%
Senger (CS)	2022-23	Fall	90768	2.73	89	25	28.09%
Feng (CS)	2020-21	Spring	13071	2.81	104	14	13.46%
Senger (CS)	2021-22	Spring	13186	2.78	109	25	22.94%

Sign Up and Sign In

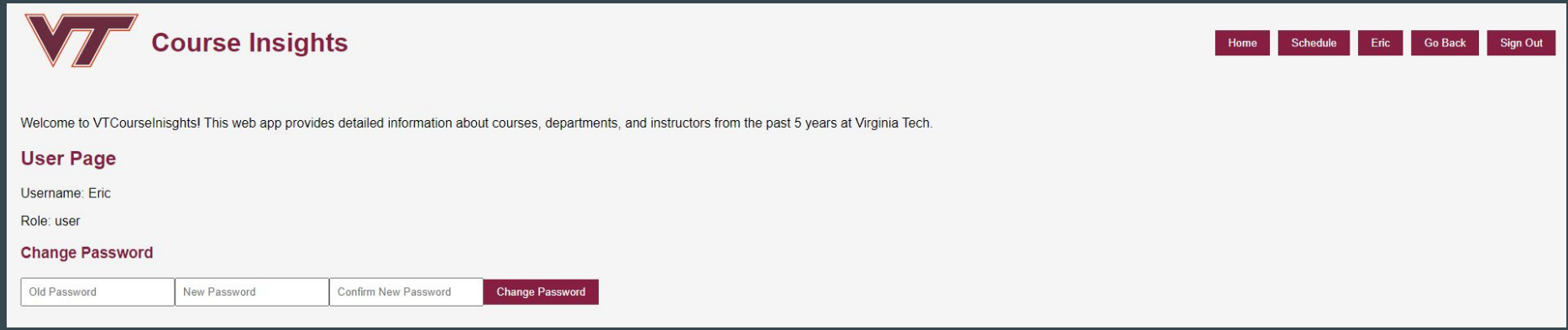




Admin Page


Course Insights
Home
Schedule
Admin
Go Back
Sign Out
Welcome to VTCourseInsights! This web app provides detailed information about courses, departments, and instructors from the past 5 years at Virginia Tech.
User Page
Username: Admin
Role: admin
Change Password
Old Password
New Password
Confirm New Password
Change Password
Create New Admin
New Admin Username
New Admin Password
Create Admin

User Page


Course Insights
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Eric
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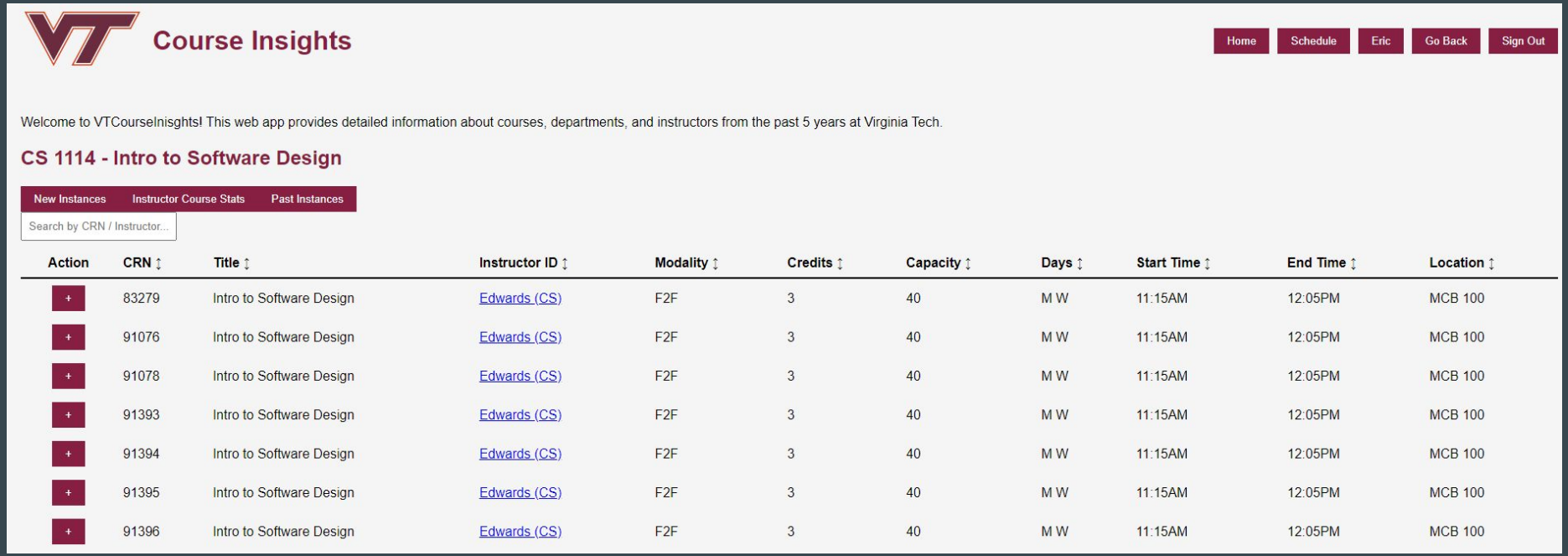
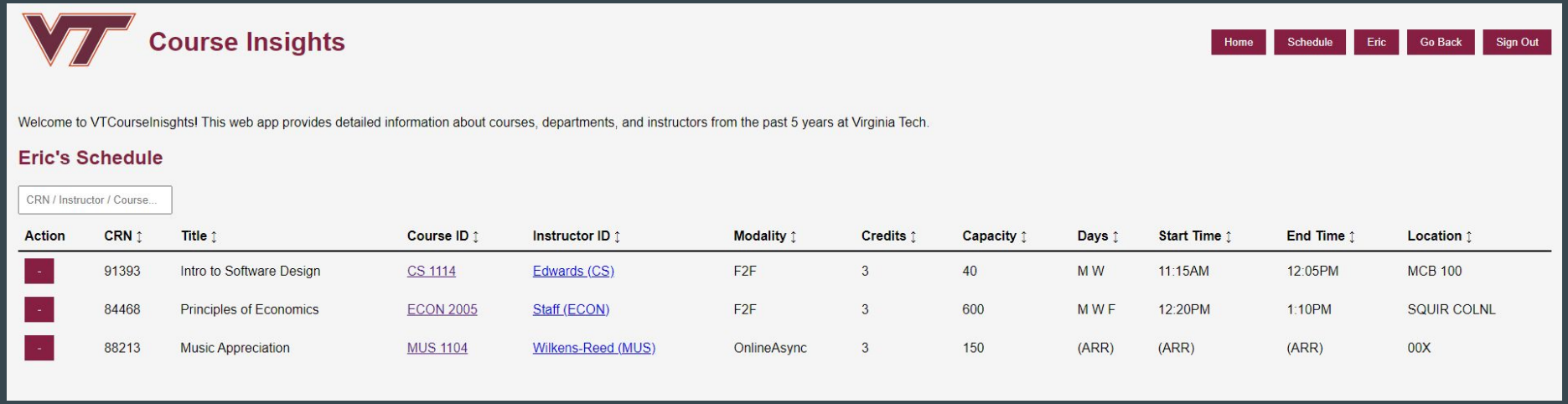
Welcome to VTCourseInsights! This web app provides detailed information about courses, departments, and instructors from the past 5 years at Virginia Tech.
User Page
Username: Eric
Role: user
Change Password
Old Password
New Password
Confirm New Password
Change Password

Course Detail - New Instances Tab - Signed In



Schedule Page - Signed In



Course Insights

Home | Schedule | Eric | Go Back | Sign Out

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Eric's Schedule

CRN / Instructor / Course...

Action	CRN	Title	Course ID	Instructor ID	Modality	Credits	Capacity	Days	Start Time	End Time	Location
-	91393	Intro to Software Design	CS 1114	Edwards (CS)	F2F	3	40	M W	11:15AM	12:05PM	MCB 100
-	84468	Principles of Economics	ECON 2005	Staff (ECON)	F2F	3	600	M W F	12:20PM	1:10PM	SQUIR COLNL
-	88213	Music Appreciation	MUS 1104	Wilkens-Reed (MUS)	OnlineAsync	3	150	(ARR)	(ARR)	(ARR)	00X

Biggest Challenges

1. Instructor Standardization: Offered course instructor data was structure differently than the distribution database. A lot of annoying edge cases with hyphens and two+ names.
2. Data Scraping: This script went through more iterations than I would like to disclose, almost made us switch topics...
3. Token authentication...

What did we learn?

1. Creating a full stack project using the extremely popular MERN stack (Mongo, Express, React, Node).
2. Debugging using the console. (Both backend and frontend consoles)
3. Updating database schemas to better fit new aspects of the overall project.
4. How to code for other eyes.