Labor Market Analysis of Skills Related to Programming and Web Development

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[There were 4,081 unique job postings for Software Developer positions in Massachusetts in March 2022. The job title most frequently advertised was “Software Engineers,” followed by “DevOps Engineers.” 31](#_Toc200374888)

## Overview

This analysis includes four separate streams of information.

* Employment and wage data are created by the Massachusetts Department of Economic Research and include estimates on both the numbers of individuals employed in target industries and occupations and the compensation earned by those workers.
* Occupational profiles include summary information from the United States Department of Labor, Employment and Training Administration Occupational Profiles for Software Developers and Web Developers
* Industry-recognized credential competency standards define the skills that must be validated by an examinee to earn the CompTIA IT Fundamentals and Certiport IT Specialist certifications. These competency standards were used to form a preliminary skills framework.
* Job postings data were collected from all online job postings across all of Massachusetts from March 2022, and the verbiage from those online advertisements aggregated and then parsed for perspective on the skills, credentials and employers most frequently mentioned.

These data will provide the bulk of the content that will be presented at the stakeholder summit. Attendees there will be asked to validate, refine or reject the elements of the preliminary instructional framework.

To make the structure of the analysis more digestible, three separate analyses are included. Each will play an important role in creating the skills profiles which will be presented to the stakeholder committees.

## Analysis Stream #1: Labor Market Position

Trends in postsecondary completions for related programs of study Employment and Wage estimates for related occupations

### Position of This Program Within the Family of Instructional Programs

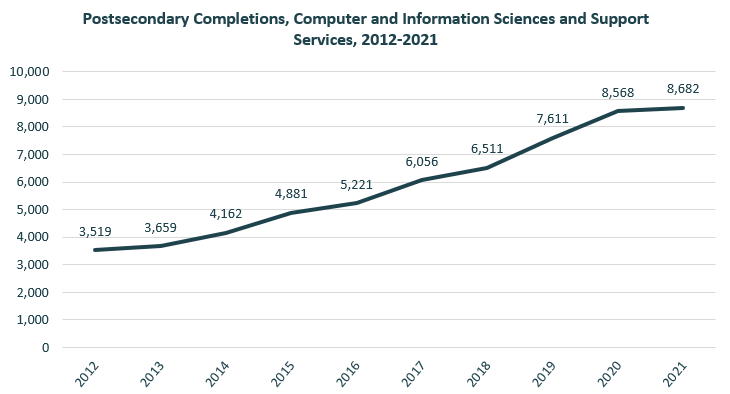
11 Computer and Information Sciences and Support Services

* 11.01 Computer and Information Sciences, General
  + 11.0101 Computer and Information Sciences, General
  + 11.0102 Artificial Intelligence
  + 11.0103 Information Technology
  + 11.0104 Informatics
  + 11.0105 Human-Centered Technology Design
  + 11.0199 Computer and Information Sciences, Other
* 11.02 Computer Programming
  + 11.0201 Computer Programming/Programmer, General
  + 11.0202 Computer Programming, Specific Applications
  + 11.0203 Computer Programming, Vendor/Product Certification
  + 11.0204 Computer Game Programming
  + 11.0205 Computer Programming, Specific Platforms
  + 11.0299 Computer Programming, Other
* 11.03 Data Processing
  + 11.0301 Data Processing and Data Processing Technology/Technician
* 11.04 Information Science/Studies
  + 11.0401 Information Science/Studies
* 11.05 Computer Systems Analysis
  + 11.0501 Computer Systems Analysis/Analyst
* 11.06 Data Entry/Microcomputer Applications
  + 11.0601 Data Entry/Microcomputer Applications, General
  + 11.0602 Word Processing
  + 11.0699 Data Entry/Microcomputer Applications, Other
* 11.07 Computer Science
  + 11.0701 Computer Science
* 11.08 Computer Software and Media Applications
  + 11.0801 Web Page, Digital/Multimedia and Information Resources Design
  + 11.0802 Data Modeling/Warehousing and Database Administration
  + 11.0803 Computer Graphics
  + 11.0804 Modeling, Virtual Environments and Simulation
  + 11.0899 Computer Software and Media Applications, Other
* 11.09 Computer Systems Networking and Telecommunications
  + 11.0901 Computer Systems Networking and Telecommunications
  + 11.0902 Cloud Computing
  + 11.0999 Computer Systems Networking and Telecommunications, Other
* 11.10 Computer/Information Technology Administration and Management
  + 11.1001 Network and System Administration/Administrator
  + 11.1002 System, Networking, and LAN/WAN Management/Manager
  + 11.1003 Computer & Information Systems Security/Auditing/Information Assurance
  + 11.1004 Web/Multimedia Management and Webmaster
  + 11.1005 Information Technology Project Management
  + 11.1006 Computer Support Specialist
  + 11.1099 Computer/IT Services Administration and Management, Other
* 11.99 Computer and Information Sciences and Support Services, Other
  + 11.9999 Computer and Information Sciences and Support Services, Other

Six postsecondary institutions offer this same program on a collegiate level:

* Harvard University
* Northshore Community College
* Quinsigamond Community College
* Massasoit Community College
* Berkshire Community College
* Bunker Hill Community College

Completions of programs within the postsecondary Computer and Information Sciences and Support Services family have seen a dramatic increase over the last ten years, although the rate of growth flattened noticeably in 2021.



### Table 1: Postsecondary Completions by Program, Top Ten, 2021

|  |  |
| --- | --- |
| **Program** | **2021 Completions** |
| Computer Science | 3,617 |
| Computer and Information Sciences, General | 1,596 |
| Information Science/Studies | 844 |
| Data Modeling/Warehousing and Database Administration | 543 |
| Computer Software and Media Applications, Other | 539 |
| Information Technology | 386 |
| Computer and Information Systems Security/Auditing/Information Assurance | 323 |
| Informatics | 142 |
| Computer Systems Networking and Telecommunications | 121 |
| Computer Programming, Specific Applications | 74 |

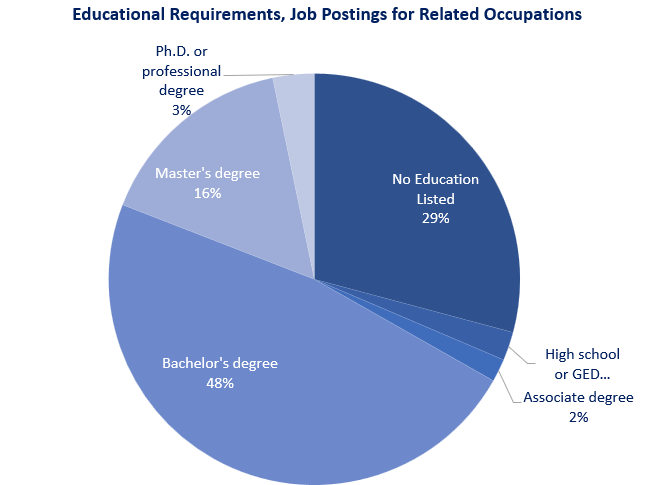
### Table 2: Target Occupations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Occupation | 2022 Jobs | Annual Openings | Median Annual Earnings | Location Quotient (2022) |
| Software Developers | 64,525 | 7,191 | $127,919 | 1.8 |
| Computer and Information Systems Managers | 23,236 | 2,203 | $162,866 | 1.8 |
| Computer Systems Analysts | 15,281 | 1,404 | $102,315 | 1.2 |
| Computer Occupations, All Other | 9,032 | 911 | $98,471 | .9 |
| Computer Programmers | 6,055 | 469 | $100,981 | 1.4 |
| Software Quality Assurance Analysts and Testers | 4,877 | 590 | $102,670 | 1.0 |
| Computer Network Support Specialists | 4,173 | 403 | $80,057 | .9 |
| Web and Digital Interface Designers | 3,331 | 328 | $74,575 | 1.3 |
| Web Developers | 3,005 | 297 | $76,436 | 1.1 |
| Computer and Information Research Scientists | 1,149 | 143 | $127,774 | 1.3 |

Combined, there are more than 134,000 jobs in these occupations in Massachusetts in 2022. That total is 45% higher than what we would expect to see in a state with this population based on national averages. Software developers and Systems Managers are found in Massachusetts at almost double the national rate. In an average year, employers in Massachusetts fill around 14,000 openings in these occupations.

These careers also pay more in Massachusetts than the national average. Across the United States, these careers average a salary of $109,730 per year, while in Massachusetts, the average is $121,494.

In March 2022, there were 8,943 unique online job postings for these occupations in Massachusetts. A large majority of these job postings (67%) required a bachelor’s degree or higher level of education.



## Analysis Stream #2: Skills Profiles

Perspectives on the tasks and technologies most relevant to the target occupations per the United States Department of Labor, Training and Employment Administration Occupation Profiles

* Software Developers
* Web Developers

### Skills Profiles

### United States Department of Labor, Employment and Training Administration Occupational Profiles

#### Software Developers

Also known as: Application Developer, Application Integration Engineer, Software Architect, Software Developer

##### Tasks

* Analyze information to determine, recommend, and plan installation of a new system or modification of an existing system.
* Analyze user needs and software requirements to determine feasibility of design within time and cost constraints.
* Confer with data processing or project managers to obtain information on limitations or capabilities for data processing projects.
* Confer with systems analysts, engineers, programmers and others to design systems and to obtain information on project limitations and capabilities, performance requirements and interfaces.
* Consult with customers or other departments on project status, proposals, or technical issues, such as software system design or maintenance.
* Coordinate installation of software system.
* Design, develop and modify software systems, using scientific analysis and mathematical models to predict and measure outcomes and consequences of design.
* Determine system performance standards.
* Develop or direct software system testing or validation procedures, programming, or documentation.
* Modify existing software to correct errors, adapt it to new hardware, or upgrade interfaces and improve performance.
* Monitor functioning of equipment to ensure system operates in conformance with specifications.
* Obtain and evaluate information on factors such as reporting formats required, costs, or security needs to determine hardware configuration.
* Prepare reports or correspondence concerning project specifications, activities, or status.
* Recommend purchase of equipment to control dust, temperature, or humidity in area of system installation.
* Specify power supply requirements and configuration.
* Store, retrieve, and manipulate data for analysis of system capabilities and requirements.
* Supervise and assign work to programmers, designers, technologists, technicians, or other engineering or scientific personnel.
* Supervise the work of programmers, technologists and technicians and other engineering and scientific personnel.
* Train users to use new or modified equipment.

##### Technologies

* Access software
* Citrix cloud computing software
* PuTTY
* Analytical or scientific software
* IBM SPSS Statistics
* Minitab
* SAS
* The MathWorks MATLAB
* Application server software
* Atlassian Bitbucket
* GitLab
* Kubernetes
* Red Hat OpenShift
* Backup or archival software
* Veritas NetBackup
* Business intelligence and data analysis software
* Alteryx software
* MicroStrategy
* Qlik Tech QlikView
* Tableau
* Cloud-based data access and sharing software
* Dropbox
* Google Drive
* Microsoft SharePoint
* Slack
* Cloud-based management software
* Amazon Web Services AWS CloudFormation
* Google Cloud software
* IBM WebSphere
* Splunk Enterprise
* Communications server software
* IBM Domino
* Computer based training software
* Moodle
* Configuration management software
* Chef
* IBM Terraform
* Perforce Helix software
* Puppet
* Content workflow software
* Atlassian JIRA
* Emerald Software Group Emerald Green Office
* Customer relationship management CRM software
* Blackbaud The Raiser's Edge
* Oracle Eloqua
* Salesforce software
* Database management system software
* Amazon DynamoDB
* Elasticsearch
* Oracle Database
* Redis
* Database reporting software
* Microsoft SQL Server Reporting Services SSRS
* Oracle Business Intelligence Discoverer
* SAP Business Intelligence
* SAP Crystal Reports
* Database user interface and query software
* Airtable
* Blackboard software
* GraphQL
* ServiceNow
* Data mining software
* Google Analytics
* Desktop communications software
* Skype
* Desktop publishing software
* Adobe Systems Adobe InDesign
* Microsoft Publisher
* Development environment software
* Microsoft Publisher
* Development environment software; Device drivers or system software; Document management software; Electronic mail software
* Apache Maven
* Go
* Oracle Java 2 Platform Enterprise Edition J2EE
* Oracle SQL Developer
* Document management software; Electronic mail software; Enterprise application integration software
* Microsoft DirectX
* Document management software; Electronic mail software; Enterprise application integration software; Enterprise resource planning ERP software
* Adobe Systems Adobe Acrobat
* Document management system software
* Electronic mail software; Enterprise application integration software; Enterprise resource planning ERP software; Enterprise system management software
* Google Gmail
* IBM Notes
* Microsoft Exchange
* Microsoft Outlook
* Enterprise application integration software; Enterprise resource planning ERP software; Enterprise system management software; Expert system software
* Atlassian Bamboo
* Extensible markup language XML
* Jenkins CI
* Microsoft SQL Server Integration Services SSIS
* Enterprise resource planning ERP software; Enterprise system management software; Expert system software; File versioning software
* Microsoft Dynamics
* Oracle Fusion Applications
* Oracle PeopleSoft
* SAP software
* File versioning software; Filesystem software
* IBM Power Systems software
* File versioning software; Filesystem software; Financial analysis software
* Ansible software
* File versioning software; Filesystem software; Financial analysis software; Graphical user interface development software
* Apache Subversion SVN
* Git
* Version control software
* Financial analysis software; Graphical user interface development software; Graphics or photo imaging software
* File server software
* Financial analysis software; Graphical user interface development software; Graphics or photo imaging software; Information retrieval or search software
* Delphi Technology
* Oracle E-Business Suite Financials.
* Graphical user interface development software; Graphics or photo imaging software; Information retrieval or search software; Instant messaging software
* Figma
* Graphical user interface GUI builder software
* Graphical user interface GUI design software
* Salesforce Visualforce
* Graphics or photo imaging software; Information retrieval or search software; Instant messaging software; Instant messaging software; Internet directory services software
* Adobe Systems Adobe Creative Cloud software
* Adobe Systems Adobe Illustrator
* JamBoard
* Trimble SketchUp Pro
* Information retrieval or search software; Instant messaging software; Internet directory services software; Internet protocol IP multimedia subsystem software
* Apache Avro
* LexisNexis
* Instant messaging software; Internet directory services software; Internet protocol IP multimedia subsystem software; Map creation software
* Blink
* GroupMe
* Metadata management software
* Microsoft Active Directory
* Metadata management software; Network conferencing software
* Voice over internet protocol VoIP system software
* Metadata management software; Network conferencing software; Network monitoring software
* ESRI ArcGIS software
* Metadata management software; Network conferencing software; Network monitoring software; Network operation system software
* CA Erwin Data Modeler
* Informatica software
* Talend Data Fabric
* Network monitoring software; Network operation system software; Network security and virtual private network VPN equipment software
* LogMeIn GoToWebinar
* Network monitoring software; Network operation system software; Network security and virtual private network VPN equipment software; Object or component-oriented development software
* Nagios
* Wireshark
* Object or component-oriented development software; Object oriented database management software
* IBM z/OS operating systems
* Object or component-oriented development software; Object oriented database management software; Office suite software
* Virtual private networking VPN software
* Object or component-oriented development software; Object oriented database management software; Office suite software; Operating system software
* Apache Spark
* jQuery
* Objective C
* TypeScript
* Object oriented data base management software; Office suite software; Operating system software; Platform interconnectivity software
* Hibernate ORM
* PostgreSQL
* Office suite software; Operating system software; Platform interconnectivity software; Portal server software
* LibreOffice
* Microsoft Office software
* Operating system software; Platform interconnectivity software; Portal server software; Presentation software
* Apple iOS
* Bash
* Microsoft Windows Server
* UNIX Shell
* Presentation software; Process mapping and design software
* Migration software
* Presentation software; Process mapping and design software; Program testing software
* Apache HTTP Server
* Presentation software; Process mapping and design software; Program testing software; Project management software
* Google Slides
* Microsoft PowerPoint
* Program testing software; Project management software; Requirements analysis and system architecture software
* Microsoft Visio
* Program testing software; Project management software; Requirements analysis and system architecture software; Spreadsheet software
* Fault testing software
* Hewlett Packard LoadRunner
* JUnit
* Selenium
* Project management software; Requirements analysis and system architecture software; Spreadsheet software; Storage networking software
* Atlassian Confluence
* Microsoft Team Foundation Server
* Microsoft Teams
* Oracle Primavera Enterprise Project Portfolio Management
* Requirements analysis and system architecture software; Spreadsheet software; Storage networking software; Transaction security and virus protection software
* IBM Rational RequisitePro
* Requirements management software
* Unified modeling language UML
* Spreadsheet software; Storage networking software; Transaction security and virus protection software; Transaction server software
* Google Sheets
* Microsoft Excel
* Storage networking software; Transaction security and virus protection software; Transaction server software; Video conferencing software
* Amazon Simple Storage Service S3
* Storage area network SAN software
* Transaction security and virus protection software; Transaction server software; Video conferencing software; Video creation and editing software
* Encryption software
* McAfee
* Norton LifeLock cybersecurity software
* Transaction server software; Video conferencing software; Video creation and editing software; Web page creation and editing software
* Customer information control system CICS
* IBM Middleware
* Microsoft Internet Information Services (IIS)
* Object Management Group Object Request Broker
* Video conferencing software; Video creation and editing software; Web page creation and editing software; Web platform development software
* Cisco Webex
* Google Meet
* LogMeIn GoToMeeting
* Zoom
* Video creation and editing software; Web page creation and editing software; Web platform development software; Word processing software
* Adobe Systems Adobe After Effects
* Flipgrid
* Screencastify
* YouTube
* Web page creation and editing software; Web platform development software; Word processing software
* Adobe Systems Adobe Dreamweaver
* Google Sites
* LinkedIn
* WordPress
* Web platform development software; Word processing software
* Bootstrap
* React
* Spring Framework
* Vue.js

##### Tools

* Central processing unit CPU processors — Graphics processing unit GPU; Multi-core central processing unit CPU
* Related occupations
* Computer servers — Application servers
* Desktop computers
* Digital cameras
* Flash memory storage card — Flash disks
* High end computer servers — Directory servers
* Integrated circuit testers — In circuit emulators ICE; Logic analyzers
* Mainframe computers
* Notebook computers

##### Detailed Work Activities

* Analyze project data to determine specifications or requirements.
* Assess database performance.
* Develop testing routines or procedures.
* Document technical specifications or requirements.
* Identify information technology project resource requirements.
* Modify software programs to improve performance.
* Monitor computer system performance to ensure proper operation.
* Develop performance metrics or standards related to information technology.
* Prepare data for analysis.
* Manage information technology projects or system activities.
* Supervise information technology personnel.
* Assign duties or work schedules to employees.
* Apply mathematical principles or statistical approaches to solve problems.
* Collaborate with others to determine design specifications or details.
* Collaborate with others to resolve information technology issues.
* Communicate project information to others.
* Provide recommendations to others about computer hardware.
* Provide technical support for software maintenance or use.
* Teach others to use computer equipment or hardware.
* Coordinate software or hardware installation.
* Design software applications

#### Web Developers

Also known as: Technology Applications Engineer, Web Architect, Web Design Specialist, Web Designer, Web Developer, Webmaster

##### Tasks

* Write supporting code for Web applications or Web sites.
* Design, build, or maintain Web sites, using authoring or scripting languages, content creation tools, management tools, and digital media.
* Back up files from Web sites to local directories for instant recovery in case of problems.
* Select programming languages, design tools, or applications.
* Evaluate code to ensure that it is valid, is properly structured, meets industry standards, and is compatible with browsers, devices, or operating systems.
* Develop databases that support Web applications and Web sites.
* Perform Web site tests according to planned schedules, or after any Web site or product revision.
* Perform or direct Web site updates.
* Maintain understanding of current Web technologies or programming practices through continuing education, reading, or participation in professional conferences, workshops, or groups.
* Analyze user needs to determine technical requirements.
* Respond to user email inquiries or set up automated systems to send responses.
* Renew domain name registrations.
* Confer with management or development teams to prioritize needs, resolve conflicts, develop content criteria, or choose solutions.
* Communicate with network personnel or Web site hosting agencies to address hardware or software issues affecting Web sites.
* Collaborate with management or users to develop e-commerce strategies and to integrate these strategies with Web sites.
* Document test plans, testing procedures, or test results.
* Establish appropriate server directory trees.
* Recommend and implement performance improvements.
* Document technical factors such as server load, bandwidth, database performance, and browser and device types.
* Develop or implement procedures for ongoing Web site revision.
* Create Web models or prototypes that include physical, interface, logical, or data models.
* Provide clear, detailed descriptions of Web site specifications, such as product features, activities, software, communication protocols, programming languages, and operating systems software and hardware.
* Evaluate or recommend server hardware or software.
* Monitor security system performance logs to identify problems and notify security specialists when problems occur.
* Install and configure hypertext transfer protocol (HTTP) servers and associated operating systems.
* Research, document, rate, or select alternatives for Web architecture or technologies.
* Develop system interaction or sequence diagrams.
* Design and implement Web site security measures, such as firewalls and message encryption.
* Incorporate technical considerations into Web site design plans, such as budgets, equipment, performance requirements, and legal issues including accessibility and privacy.

##### Technologies

* Analytical or scientific software
  + IBM SPSS Statistics
  + SAS
  + The MathWorks MATLAB
* Application server software
  + Atlassian Bitbucket
  + Docker
  + Red Hat OpenShift
  + Spring Boot
* Business intelligence and data analysis software
  + IBM Cognos Impromptu
  + MicroStrategy
  + Qlik Tech QlikView
  + Tableau
* Cloud-based data access and sharing software
  + Dropbox
  + Google Drive
  + Microsoft SharePoint
  + Slack
* Cloud-based data access and sharing software
  + Amazon Web Services AWS CloudFormation
  + Google Cloud software
  + IBM WebSphere
  + Splunk Enterprise
* Communications server software
  + IBM Domino
* Computer based training software
  + Moodle
* Configuration management software
  + Chef
  + Perforce Helix software
  + Puppet
* Content workflow software
  + Atlassian JIRA
  + Sitecore CMS
* Customer relationship management CRM software
  + Oracle Eloqua
  + Salesforce software
* Data base management system software
  + Amazon DynamoDB
  + Apache Hive
  + Elasticsearch
  + Redis
* Data base reporting software
  + Microsoft SQL Server Reporting Services
  + SSRS
  + SAP Crystal Reports
* Data base user interface and query software
  + Airtable
  + Blackboard software
  + GraphQL
  + Transact-SQL
* Data mining software
  + Google Analytics
* Desktop communications software
  + Skype
* Desktop publishing software
  + Adobe Systems Adobe InDesign
  + Microsoft Publisher
* Development environment software
  + Apache Maven
* Development environment software
  + Apache Subversion SVN
* Development environment software
  + Go
  + Oracle Java 2 Platform Enterprise Edition J2EE
* Document management software
  + Adobe Systems Adobe Acrobat
* Electronic mail software
  + IBM Notes
* Enterprise application integration software
  + Atlassian Bamboo
  + Extensible markup language XML
  + IBM InfoSphere DataStage
  + Microsoft SQL Server Integration Services SSIS
* Enterprise resource planning ERP software
  + Microsoft Dynamics
  + Oracle Fusion Applications
  + Oracle JD Edwards EnterpriseOne
  + SAP software
* Enterprise system management software
  + IBM Power Systems software
* Expert system software
  + Ansible software
* File versioning software
  + Git
* Financial analysis software
  + Delphi Technology
* Geographic information system
  + ESRI ArcGIS software
  + Geographic information system GIS software
* Graphical user interface development software
  + Figma
  + Salesforce Visualforce
* Graphics or photo imaging software
  + Adobe Systems Adobe Creative Cloud software
  + Adobe Systems Adobe Illustrator
  + JamBoard
  + Trimble SketchUp Pro
* Instant messaging software
  + Atlassian HipChat
  + Blink
* Medical software
  + Epic Systems
* Metadata management software
  + CA Erwin Data Modeler
* Network monitoring software
  + Nagios
  + Wireshark
* Object or component-oriented development software
  + Apache Spark
  + jQuery
  + Objective C
  + TypeScript
* Object oriented data base management software
  + Hibernate ORM
  + PostgreSQL
* Office suite software
  + Microsoft Office software
* Operating system software
  + Bash
  + Microsoft Windows Server
  + Shell script
  + UNIX Shell
* Portal server software
  + Apache HTTP Server
* Presentation software
  + Apple Keynote
  + Google Slides
* Process mapping and design software
  + InVision software
  + Microsoft Visio
* Program testing software
  + Hewlett Packard LoadRunner
  + JUnit
  + Selenium
  + Travis
* Project management software
  + Atlassian Confluence
  + Microsoft Project
* Requirements analysis and system architecture software
  + Unified modeling language UML
* Storage networking software
  + Amazon Simple Storage Service S3
* Transaction security and virus protection software
  + Norton LifeLock cybersecurity software
* Transaction server software
  + Customer information control system CICS
  + Microsoft Internet Information Services (IIS)
* Video conferencing software
  + Cisco Webex
  + Google Meet
* Video creation and editing software
  + Adobe Systems Adobe After Effects
  + Flipgrid
  + Screencastify
  + YouTube
* Web page creation and editing software
  + Facebook
  + Google Sites
  + LinkedIn
  + WordPress
* Web platform development software
  + Bootstrap
  + React
  + Spring Framework
  + Vue.js

##### Tools

* Computer servers — Application servers; Web servers
* Desktop computers
* High-capacity removable media drives — Universal serial bus USB flash drives
* Notebook computers — Laptop computers
* Personal computers

##### Detailed Work Activities

* Design websites or web applications.
* Write computer programming code.
* Update website content.
* Create electronic data backup to prevent loss of information.
* Test software performance.
* Create databases to store electronic data.
* Update knowledge about emerging industry or technology trends.
* Analyze project data to determine specifications or requirements.
* Collaborate with others to resolve information technology issues.
* Monitor the security of digital information.
* Provide customer service to clients or users.
* Document design or development procedures.
* Collaborate with others to develop or implement marketing strategies.
* Provide technical support for computer network issues.
* Configure computer networks.

## Analysis Stream #3: Industry Recognized Credentials

Competency models from the CompTIA IT Fundamentals+ and CompTIA Linux+ Certifications

### Industry Recognized Credentials

#### CompTIA IT Fundamentals+

##### Performance Objectives

* Set up a computer workstation and use basic software applications.
* Explain the functions and types of devices used within a computer system.
* Apply basic computer maintenance and support principles.
* Describe some principles of software and database development.
* Configure computers and mobile devices to connect to home networks and to the Internet.
* Identify security issues affecting the use of computers and networks.

##### Domains

1. Using Computers
   * Common Computing Devices
   * Using a Workstation
   * Using an OS
   * Managing an OS
   * Troubleshooting and Support
2. Using Apps and Databases
   * Using Data Types and Units
   * Using Apps
   * Programming and App Development
   * Using Databases
3. Using Computer Hardware
   * System Components
   * Using Device Interfaces
   * Using Peripheral Devices
   * Using Storage Devices
   * Using File Systems
4. Using Networks
   * Networking Concepts
   * Connecting to a Network
   * Secure Web Browsing
   * Using Shared Storage
   * Using Mobile Devices
5. Security Concepts
   * Security Concerns
   * Using Best Practices
   * Using Access Controls
   * Behavioral Security Concepts

#### CompTIA Linux+

##### Performance Objectives

* Describe history and features of Linux
* Manage files and directories
* Describe foundational concepts of documentation
* Describe foundational concepts of troubleshooting
* Implement identity management
* Configure and execute remote connectivity for system management
* Analyze and troubleshoot user access and file permissions
* Apply the appropriate access controls
* Create simple shell scripts to automate common tasks
* Build and install software
* Manage software configurations
* Summarize Linux fundamentals
* Use the appropriate networking tools or configuration files
* Analyze and troubleshoot storage issues
* Analyze and troubleshoot central processing unit (CPU) and memory issues
* Configure and use the appropriate processes and services
* Use of security best practices in a Linux environment
* Use system to diagnose and resolve common problems with a Linux system
* Analyze and troubleshoot network resource issues
* Implement and configure firewalls
* Summarize common infrastructure as code technologies
* Perform basic version control using Git
* Perform basic container operations
* Summarize container, cloud, and orchestration concepts

##### Domains

1. Lesson 1: Introducing Linux

* Topic 1A: Identify Linux Characteristics
* Topic 1B: Understand Bash Interaction with Linux
* Topic 1C: Use Help in Linux
* Topic 1D: Identify the Linux Troubleshooting Methodology
* Administering Users and Groups
* Topic 2A: Manage User Accounts
* Topic 2B: Manage Group Accounts
* Topic 2C: Configure Privilege Escalation
* Topic 2D: Troubleshoot User and Group Issues
* Configuring Permissions
* Topic 3A: Configure Standard Linux Permissions
* Topic 3B: Configure Special Linux Permissions
* Topic 3C: Configure Access Control Lists
* Implementing File Management
* Topic 4A: Understand the Linux File System
* Topic 4B: Use File Management Commands
* Topic 4C: Find File Locations
* Authoring Text Files
* Topic 5A: Edit Text Files
* Topic 5B: Manage Text Files
* Managing Software
* Topic 6A: Understand Software Management
* Topic 6B: Manage RPM Software Packages and Repositories
* Topic 6C: Manage Debian-based Software Packages and Repositories
* Topic 6D: Compile from Source Code
* Topic 6E: Acquire Software
* Topic 6F: Run Software in a Sandbox
* Administering Storage
* Topic 7A: Understand Storage
* Topic 7B: Deploy Storage
* Topic 7C: Manage Other Storage Options
* Topic 7D:Troubleshoot Storage
* Managing Devices, Processes, Memory, and the Kernel
* Topic 8A: Gather Hardware Information
* Topic 8B: Manage Processes
* Topic 8C: Manage Memory
* Topic 8D: Manage the Linux Kernel
* Managing Services
* Topic 9A: Manage System Services
* Topic 9B: Configure Common System Services
* Topic 9C: Configure Localization Settings
* Configuring Network Settings
* Topic 10A: Understand Network Fundamentals
* Topic 10B: Manage Network Settings
* Topic 10C: Configure Remote Administrative Access
* Topic 10D: Troubleshoot the Network
* Configuring Network Security
* Topic 11A: Configure the Firewall
* Topic 11B: Monitor Network Traffic
* Managing Linux Security
* Topic 12A: Harden a Linux System
* Topic 12B: Manage Certificates
* Topic 12C: Understand Authentication
* Topic 12D: Configure SELinux or AppArmor
* Implementing Simple Scripts
* Topic 13A: Understand Bash Scripting Basics
* Topic 13B: Use Shell Script Elements
* Topic 13C: Implement Scripts with Logical Controls
* Using Infrastructure as Code
* Topic 14A: Understand Infrastructure as Code
* Topic 14B: Implement Orchestration
* Topic 14C: Manage Version Control with Git
* Managing Containers in Linux
* Topic 15A: Understand Containers
* Topic 15B: Deploy Containers
* Topic 15C: Understand Virtualization Concepts
* Installing Linux
* Topic 16A: The Linux Boot Process
* Topic 16B: Modify Boot Settings
* Topic 16C: Deploy Linux

## Analysis Stream #4: Job Postings Analysis

Job postings data were collected from all online job postings across all of Massachusetts from March 2022, and the verbiage from those online advertisements aggregated and then parsed for perspective on the skills, credentials and employers most frequently mentioned.

### Job Posting Analysis

There were 4,081 unique job postings for Software Developer positions in Massachusetts in March 2022. The job title most frequently advertised was “Software Engineers,” followed by “DevOps Engineers.”

#### Tables 3 and 4: Unique Job Postings

|  |  |
| --- | --- |
| Job Title | Unique Postings |
| Software Engineers | 601 |
| DevOps Engineers | 154 |
| Principal Software Engineers | 148 |
| Full Stack Software Engineers | 105 |
| Software Developers | 63 |
| Lead Software Engineers | 61 |
| .NET Developers | 57 |
| Software Development Engineers | 55 |
| Software Engineering Managers | 54 |
| Salesforce Developers | 48 |
| Java Developers | 47 |
| Storage and Virtualization Engineers | 47 |
| Java Engineers | 46 |
| Job Title | Unique Postings |
| Embedded Software Engineers | 41 |
| Principal Engineers | 40 |
| Full Stack Developers | 39 |
| Data Software Engineers | 33 |
| Staff Software Engineers | 32 |
| Full Stack Java Developers | 31 |
| Full Stack Engineers | 31 |

#### Table 5: Top Companies

|  |  |
| --- | --- |
| Employer | Unique Postings |
| Dell Technologies | 219 |
| Amazon | 101 |
| Randstad | 77 |
| Motion Recruitment | 70 |
| Jobot | 68 |
| The Judge Group | 58 |
| CyberCoders | 45 |
| Deloitte | 41 |
| Fidelity Investments | 37 |
| State Street | 36 |
| Employer | Unique Postings |
| Arrow Electronics | 35 |
| Humana | 35 |

#### Table #6 Top Skills

|  |  |
| --- | --- |
| Skill | % of Postings |
| Communications | 38% |
| Management | 19% |
| Problem Solving | 18% |
| Troubleshooting | 18% |
| Leadership | 17% |

Across the Commonwealth, 475 online job postings specifically requested the CompTIA IT Fundamentals Certification in March 2022. A number of observations are detailed below.

#### CompTIA:

* 475 postings
* $57,000 median advertised salary
* Three-year wage trend +14.2%

##### Employers:

* Raytheon
* Robert Half
* Deloitte
* Capgemini
* General Dynamics

##### Top Job Titles:

* Desktop Support Technicians
* Systems Administrators
* Field Service Technicians

##### Top qualifications

* A+
* Security+
* Network+
* CISSP
* Security Clearance