SPACEX

NIELIT - 'O' LEVEL

SUBMITTED BY:-

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STUDY CENTER	NIELIT, KOLKATA
SESSION	2016-2017

ACKNOWLEDGEMENTS

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I am again thankful to Prof. Saikat Sengupta for the suggestion during all discussions which proved to be a milestone in completion of this work and his help in final proof reading of this draft.

Finally I would like to express my sincere thanks to NIELIT for providing suitable environment in the department during my project work. I am indebted to the authorities of the Institute for providing me with the necessary facilities to accomplish this work.

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SPACEX

INTRODUCTION

SpaceX designs, manufactures and launches advanced rockets and spacecraft. The company was founded in 2002 to revolutionize space technology, with the ultimate goals of enabling people to live on other planets.

MAKING HISTORY

SpaceX has gained worldwide attention for a series of historic milestones. It is the only private company ever to return a spacecraft from low-Earth orbit, which it first accomplished in December 2010. The company made history again in May 2012 when its dragon spacecraft delivered cargo to and from the International Space Station – a challenging feat previously accomplished only by governments. Since then Dragon has delivered cargo to and from the space station multiple times, providing regular cargo resupply missions for NASA. In 2017, SpaceX successfully achieved the first reflight of an orbital class rocket- a historic milestone on the road to full and rapid rocket reusability.

ADVANCING THE FUTURE

SpaceX is flying numerous cargo resupply missions to the International Space Station, for a total of at least 20 flights under the Commercial Resupply_Services contract. In 2016, NASA awarded SpaceX a second version of that contract that will cover a minimum of 6 additional flights from 2019 onwards. Dragon was designed from the outset to carry astronauts to space, and as early as 2018, SpaceX will carry crew as part of NASA's Commercial Crew Program. As one of the world's fastest growing provider of launch services, SpaceX has secured over 100 missions to its manifest , representing over $12 billion in contracts. These include commercial satellite launches as well as NASA and other US Government missions. Currently under development is Falcon Heavy, which will be the world's most powerful rocket. All the while, SpaceX continues to work toward one of its key goals- developing fully and rapidly reusable rockets, a feat that will transform space exploration by delivering highly reliable vehicles at radically reduced costs.

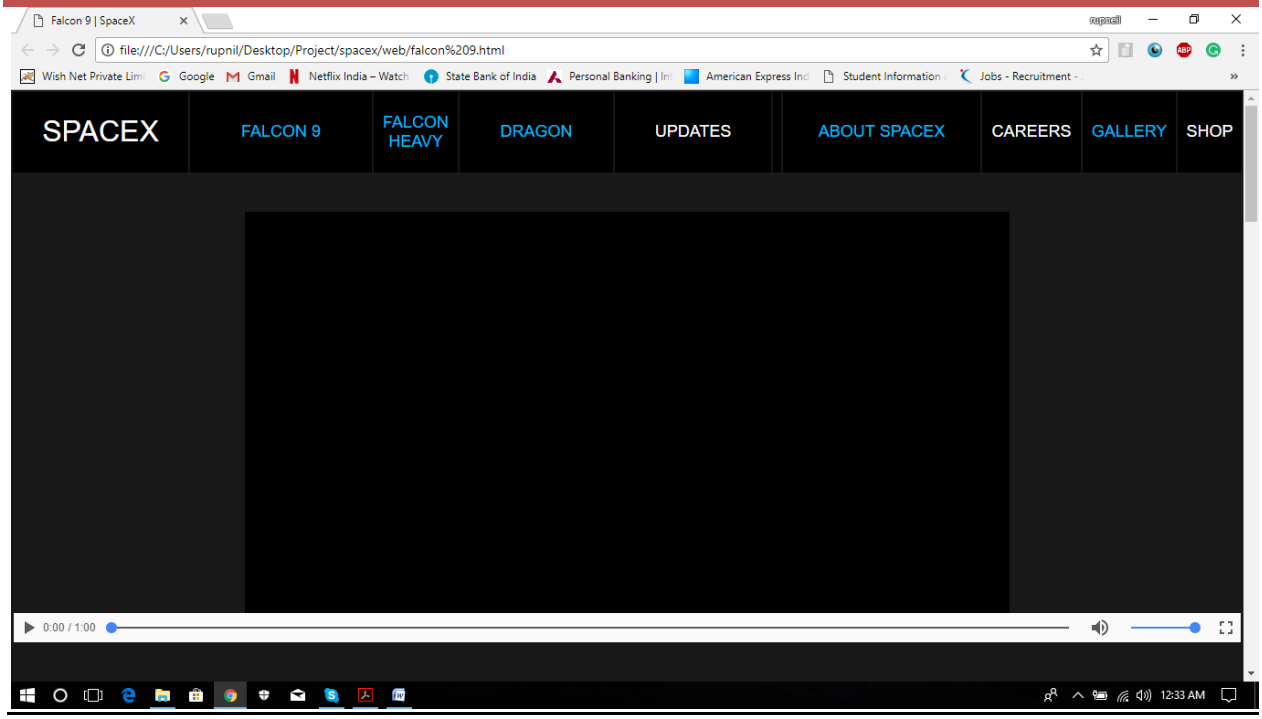
SYSTEM CONFIGURATION

HARDWARE REQUIREMENTS:-	
Processor	Intel® Core™ i3-4010U CPU @ 1.70GHz 1.70 GHz
Ram	DDR3 2.0 GB RAM
Disk Space	

SOFTWARE REQUIREMENTS:-	
Operating System	Windows Xp, Vista, 7, 8, 10
Browser	IE, Google Chrome, Firefox

SCREEN SHOTS

falcon 9.html



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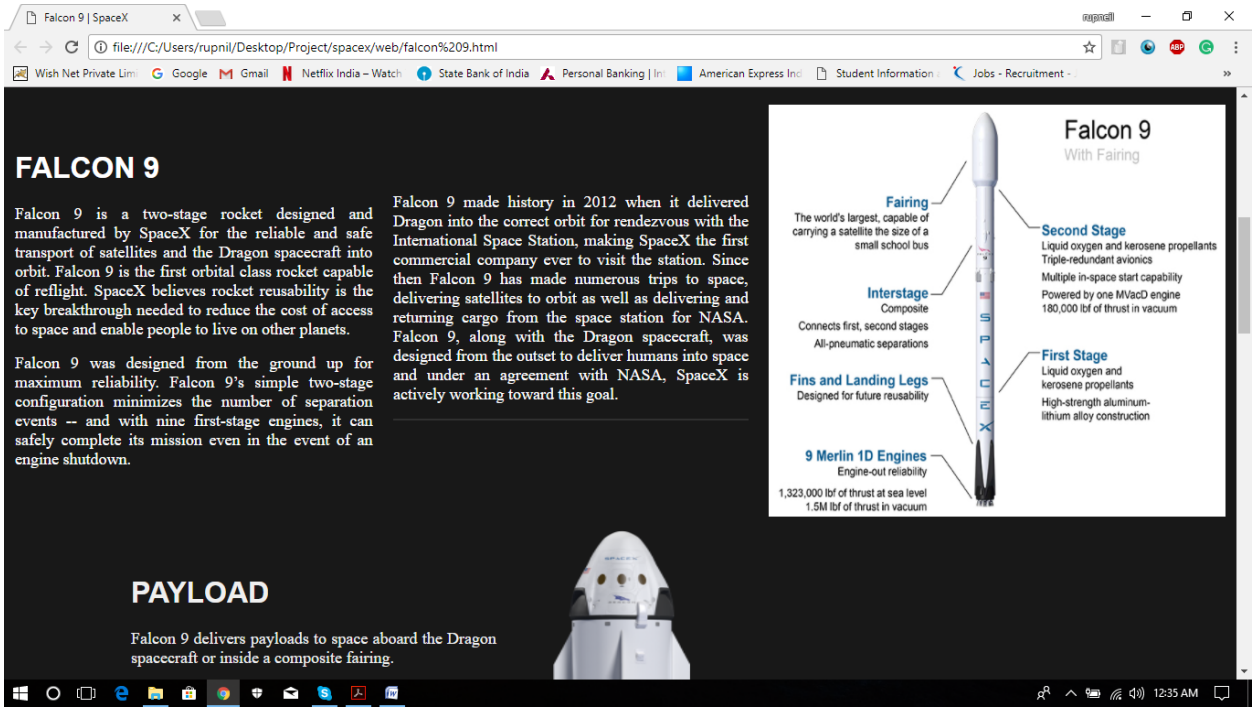

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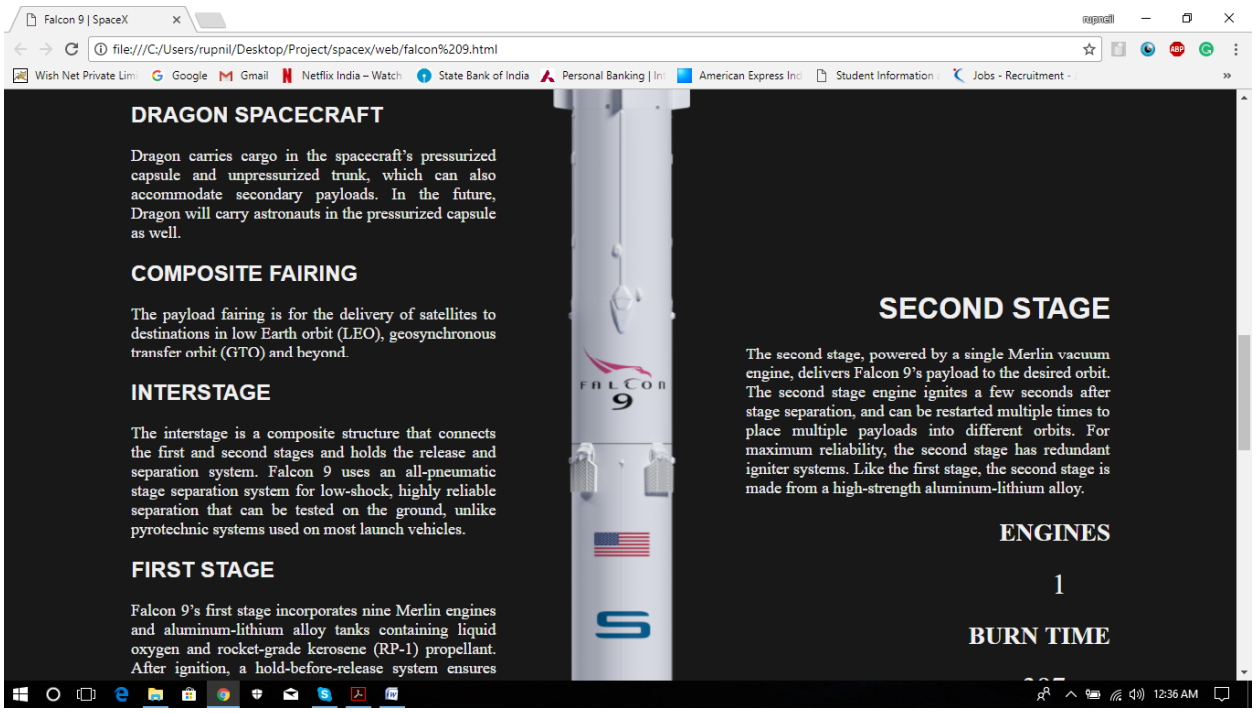
Falcon 9 | SpaceX
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DRAGON SPACECRAFT
Dragon carries cargo in the spacecraft's pressurized capsule and unpressurized trunk, which can also accommodate secondary payloads. In the future, Dragon will carry astronauts in the pressurized capsule as well.
COMPOSITE FAIRING
The payload fairing is for the delivery of satellites to destinations in low Earth orbit (LEO), geosynchronous transfer orbit (GTO) and beyond.
INTERSTAGE
The interstage is a composite structure that connects the first and second stages and holds the release and separation system. Falcon 9 uses an all-pneumatic stage separation system for low-shock, highly reliable separation that can be tested on the ground, unlike pyrotechnic systems used on most launch vehicles.
FIRST STAGE
Falcon 9's first stage incorporates nine Merlin engines and aluminum-lithium alloy tanks containing liquid oxygen and rocket-grade kerosene (RP-1) propellant. After ignition, a hold-before-release system ensures
FALCON 9
SECOND STAGE
The second stage, powered by a single Merlin vacuum engine, delivers Falcon 9's payload to the desired orbit. The second stage engine ignites a few seconds after stage separation, and can be restarted multiple times to place multiple payloads into different orbits. For maximum reliability, the second stage has redundant igniter systems. Like the first stage, the second stage is made from a high-strength aluminum-lithium alloy.
ENGINES
1
BURN TIME
12:36 AM

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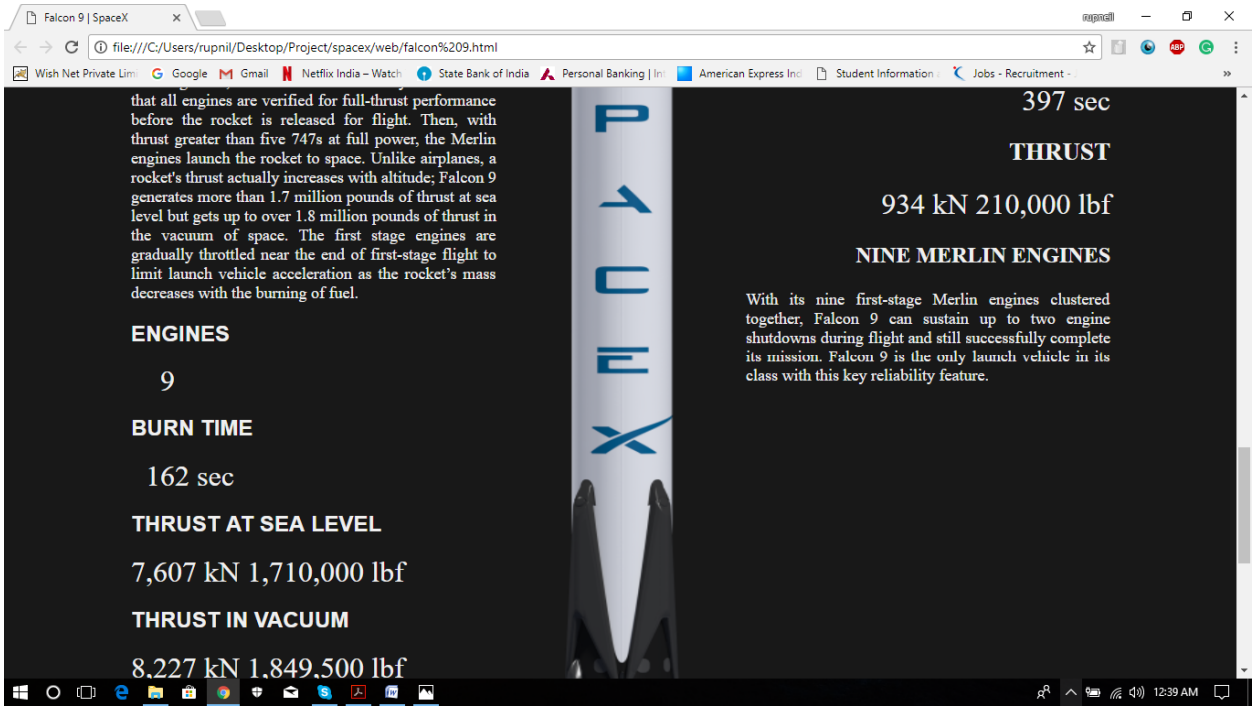
Falcon 9 | SpaceX
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that all engines are verified for full-thrust performance before the rocket is released for flight. Then, with thrust greater than five 747s at full power, the Merlin engines launch the rocket to space. Unlike airplanes, a rocket's thrust actually increases with altitude; Falcon 9 generates more than 1.7 million pounds of thrust at sea level but gets up to over 1.8 million pounds of thrust in the vacuum of space. The first stage engines are gradually throttled near the end of first-stage flight to limit launch vehicle acceleration as the rocket's mass decreases with the burning of fuel.
ENGINES
9
BURN TIME
162 sec
THRUST AT SEA LEVEL
7,607 kN 1,710,000 lbf
THRUST IN VACUUM
8,227 kN 1,849,500 lbf
SPACEX
397 sec
THRUST
934 kN 210,000 lbf
NINE MERLIN ENGINES
With its nine first-stage Merlin engines clustered together, Falcon 9 can sustain up to two engine shutdowns during flight and still successfully complete its mission. Falcon 9 is the only launch vehicle in its class with this key reliability feature.
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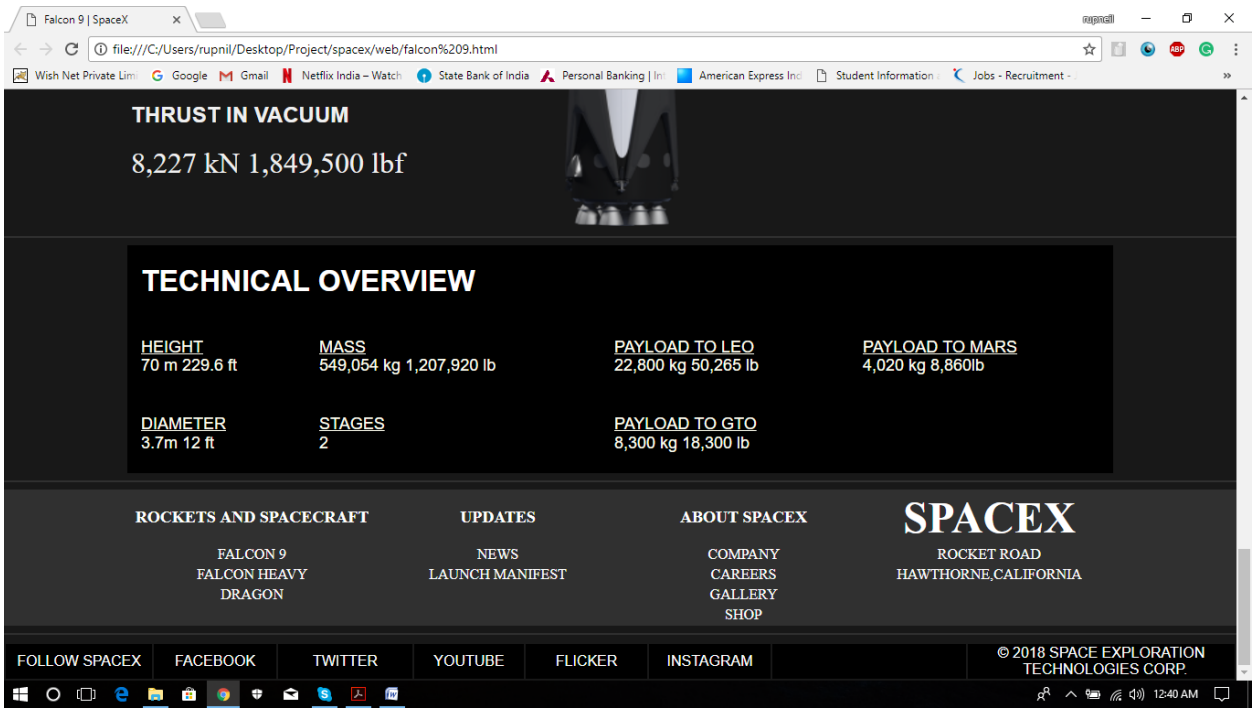
Falcon 9 | SpaceX
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THRUST IN VACUUM
8,227 kN 1,849,500 lbf
TECHNICAL OVERVIEW
HEIGHT
70 m 229.6 ft
MASS
549,054 kg 1,207,920 lb
PAYLOAD TO LEO
22,800 kg 50,265 lb
PAYLOAD TO MARS
4,020 kg 8,860lb
DIAMETER
3.7m 12 ft
STAGES
2
PAYLOAD TO GTO
8,300 kg 18,300 lb
ROCKETS AND SPACECRAFT
FALCON 9
FALCON HEAVY
DRAGON
UPDATES
NEWS
LAUNCH MANIFEST
ABOUT SPACEX
COMPANY
CAREERS
GALLERY
SHOP
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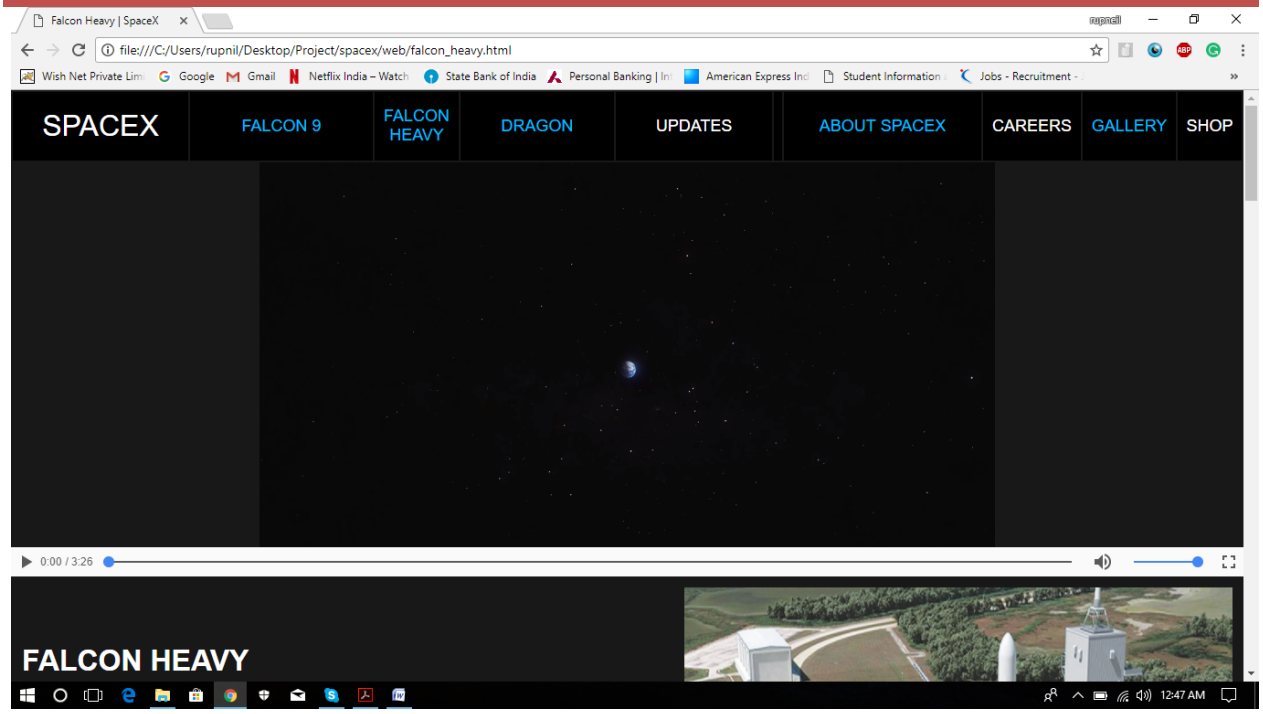
falcon_heavy.html



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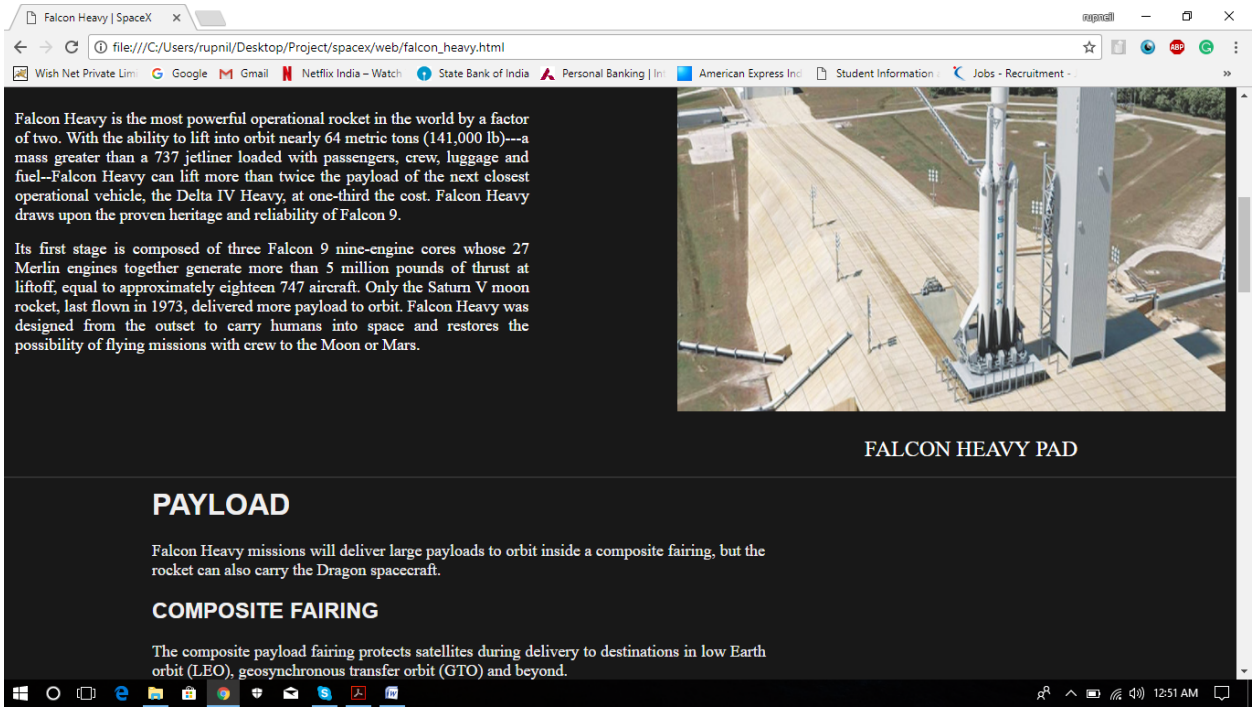

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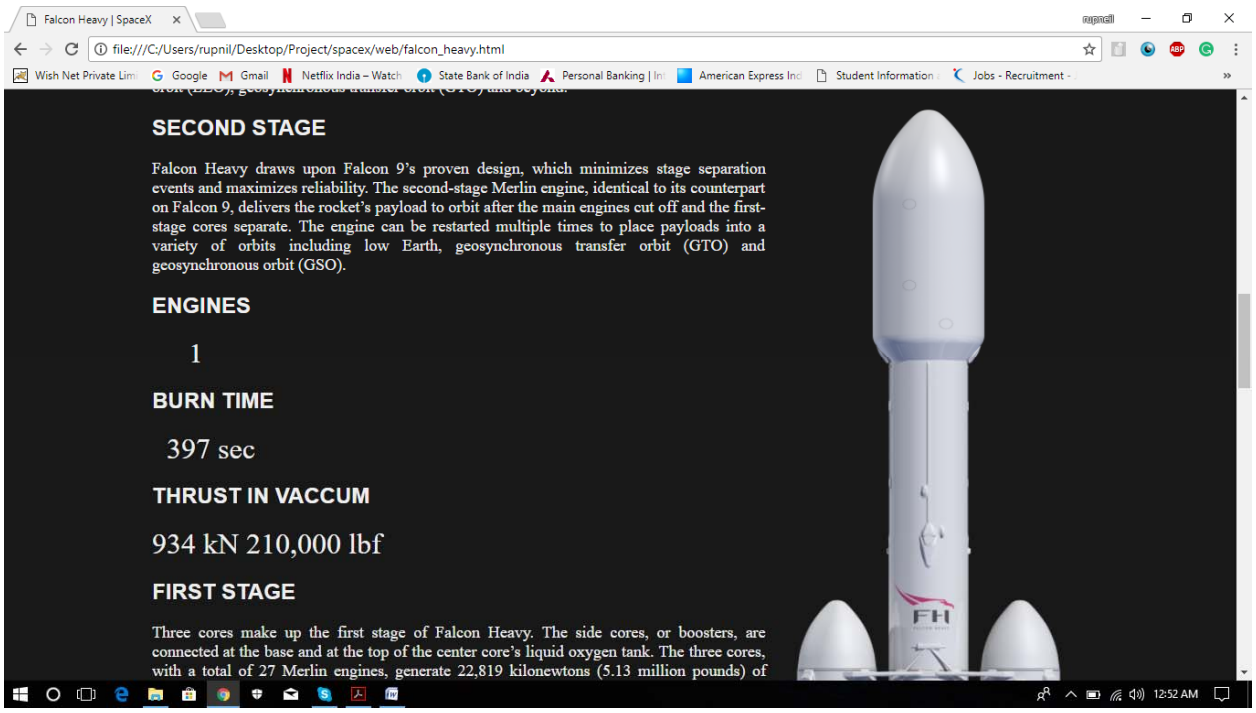
Falcon Heavy | SpaceX
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SECOND STAGE
Falcon Heavy draws upon Falcon 9's proven design, which minimizes stage separation events and maximizes reliability. The second-stage Merlin engine, identical to its counterpart on Falcon 9, delivers the rocket's payload to orbit after the main engines cut off and the first-stage cores separate. The engine can be restarted multiple times to place payloads into a variety of orbits including low Earth, geosynchronous transfer orbit (GTO) and geosynchronous orbit (GSO).
ENGINES
1
BURN TIME
397 sec
THRUST IN VACCUM
934 kN 210,000 lbf
FIRST STAGE
Three cores make up the first stage of Falcon Heavy. The side cores, or boosters, are connected at the base and at the top of the center core's liquid oxygen tank. The three cores, with a total of 27 Merlin engines, generate 22,819 kilonewtons (5.13 million pounds) of
12:52 AM

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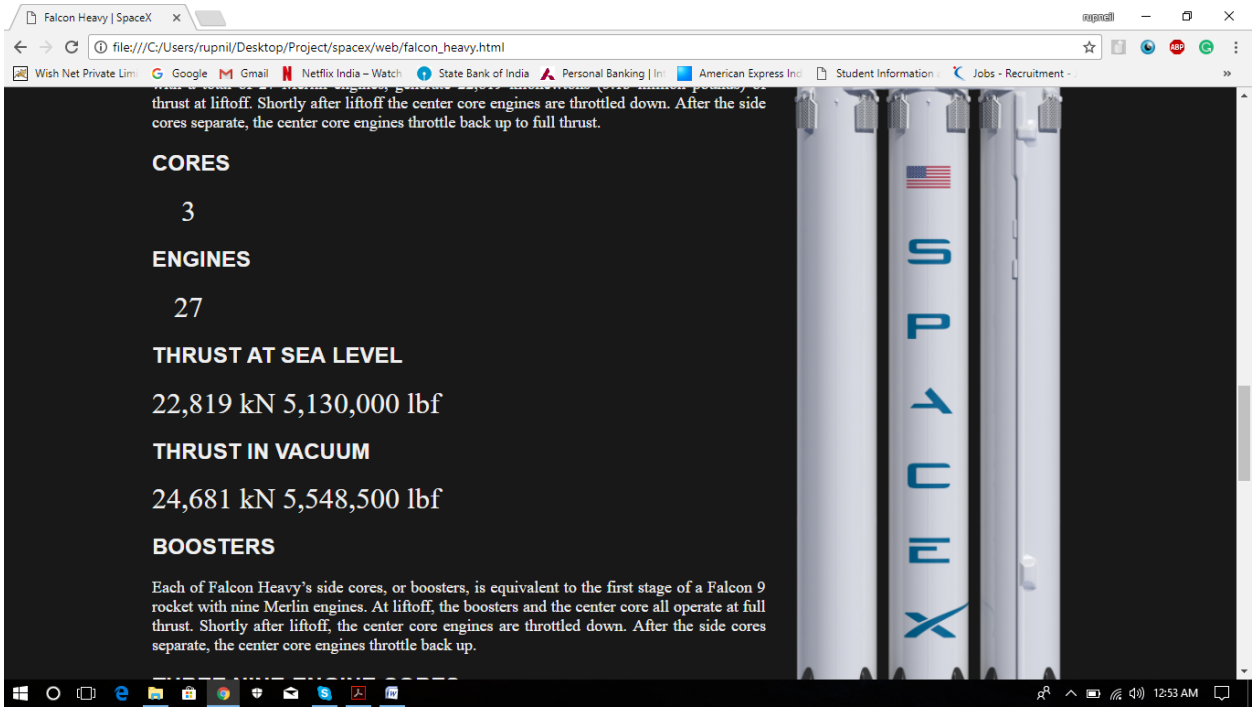
Falcon Heavy | SpaceX
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thrust at liftoff. Shortly after liftoff the center core engines are throttled down. After the side cores separate, the center core engines throttle back up to full thrust.
CORES
3
ENGINES
27
THRUST AT SEA LEVEL
22,819 kN 5,130,000 lbf
THRUST IN VACUUM
24,681 kN 5,548,500 lbf
BOOSTERS
Each of Falcon Heavy's side cores, or boosters, is equivalent to the first stage of a Falcon 9 rocket with nine Merlin engines. At liftoff, the boosters and the center core all operate at full thrust. Shortly after liftoff, the center core engines are throttled down. After the side cores separate, the center core engines throttle back up.
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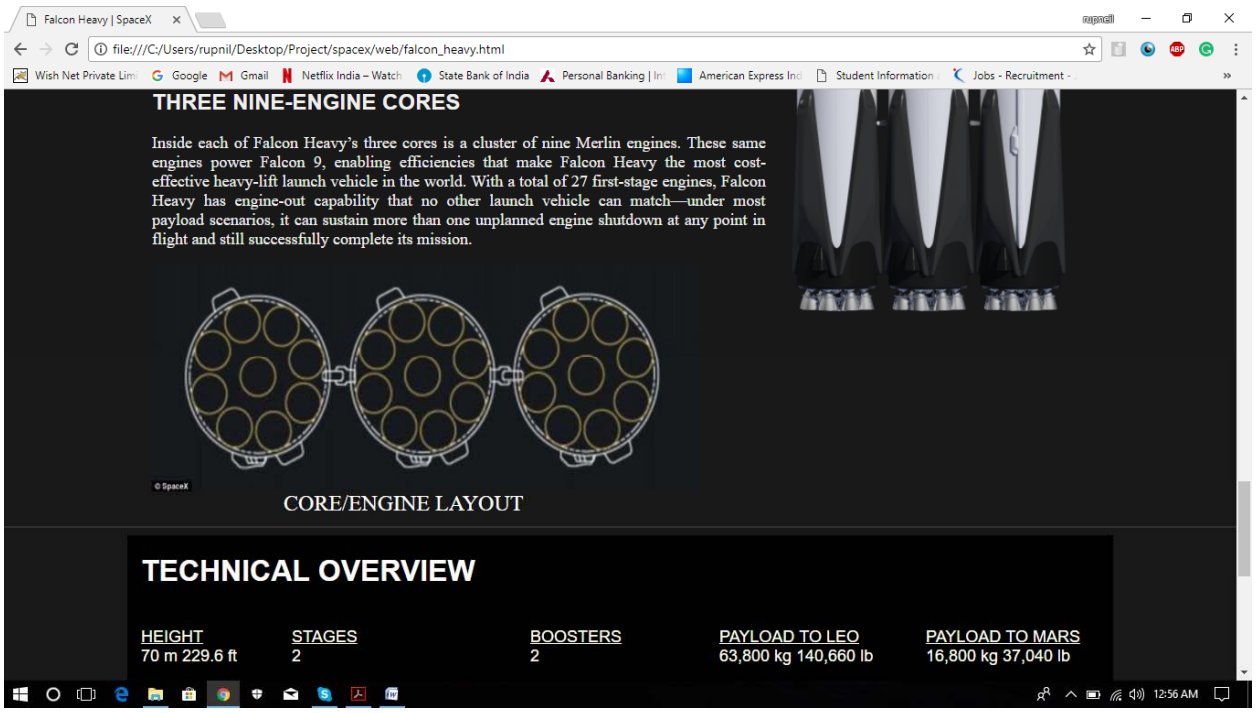
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THREE NINE-ENGINE CORES
Inside each of Falcon Heavy's three cores is a cluster of nine Merlin engines. These same engines power Falcon 9, enabling efficiencies that make Falcon Heavy the most cost-effective heavy-lift launch vehicle in the world. With a total of 27 first-stage engines, Falcon Heavy has engine-out capability that no other launch vehicle can match—under most payload scenarios, it can sustain more than one unplanned engine shutdown at any point in flight and still successfully complete its mission.
© SpaceX
CORE/ENGINE LAYOUT
TECHNICAL OVERVIEW
HEIGHT
70 m 229.6 ft
STAGES
2
BOOSTERS
2
PAYLOAD TO LEO
63,800 kg 140,660 lb
PAYLOAD TO MARS
16,800 kg 37,040 lb
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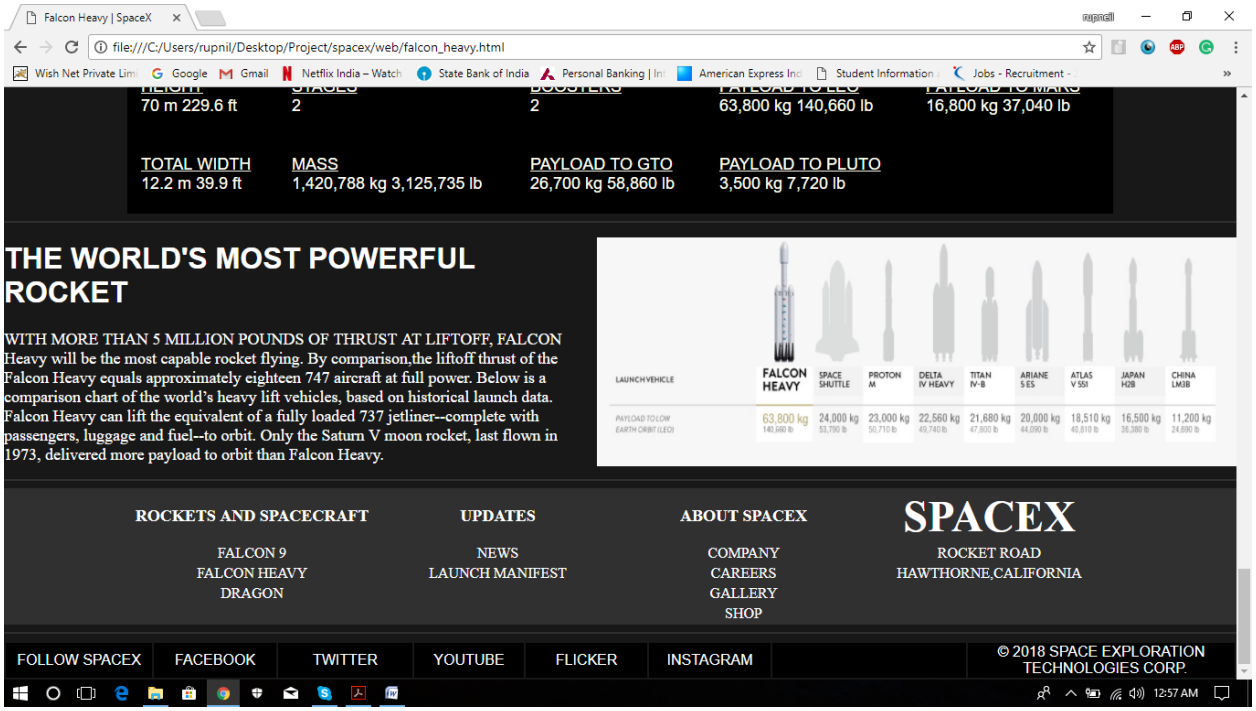
Falcon Heavy | SpaceX
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70 m 229.6 ft
2
2
63,800 kg 140,660 lb
16,800 kg 37,040 lb
TOTAL WIDTH
12.2 m 39.9 ft
MASS
1,420,788 kg 3,125,735 lb
PAYLOAD TO GTO
26,700 kg 58,860 lb
PAYLOAD TO PLUTO
3,500 kg 7,720 lb
THE WORLD'S MOST POWERFUL ROCKET
WITH MORE THAN 5 MILLION POUNDS OF THRUST AT LIFTOFF, FALCON Heavy will be the most capable rocket flying. By comparison,the liftoff thrust of the Falcon Heavy equals approximately eighteen 747 aircraft at full power. Below is a comparison chart of the world's heavy lift vehicles, based on historical launch data. Falcon Heavy can lift the equivalent of a fully loaded 737 jetliner--complete with passengers, luggage and fuel--to orbit. Only the Saturn V moon rocket, last flown in 1973, delivered more payload to orbit than Falcon Heavy.
LAUNCH VEHICLE
FALCON HEAVY
SPACE SHUTTLE
PROTON M
DELTA IV HEAVY
TITAN IV-B
ARIANE 5 ES
ATLAS V 551
JAPAN H2B
CHINA LM3B
63,800 kg
24,000 kg
23,000 kg
22,560 kg
21,680 kg
20,000 kg
18,510 kg
16,500 kg
11,200 kg
ROCKETS AND SPACECRAFT
FALCON 9
FALCON HEAVY
DRAGON
UPDATES
NEWS
LAUNCH MANIFEST
ABOUT SPACEX
COMPANY
CAREERS
GALLERY
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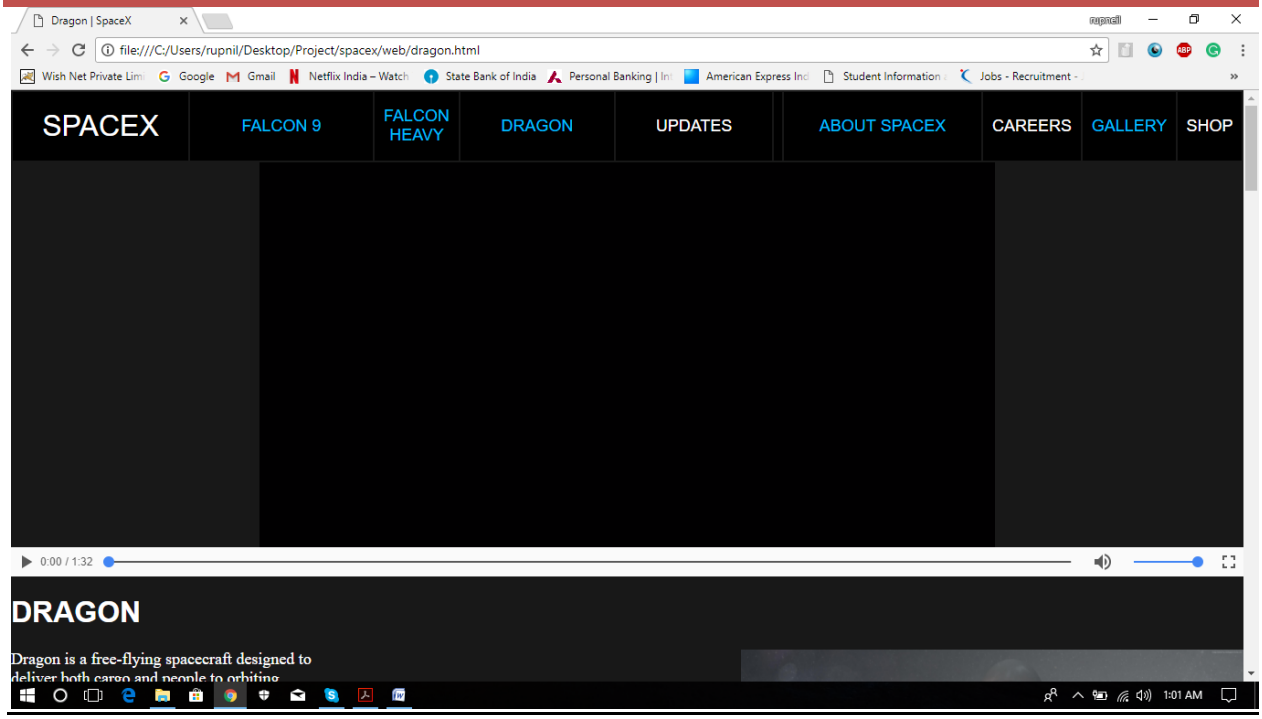
dragon.html



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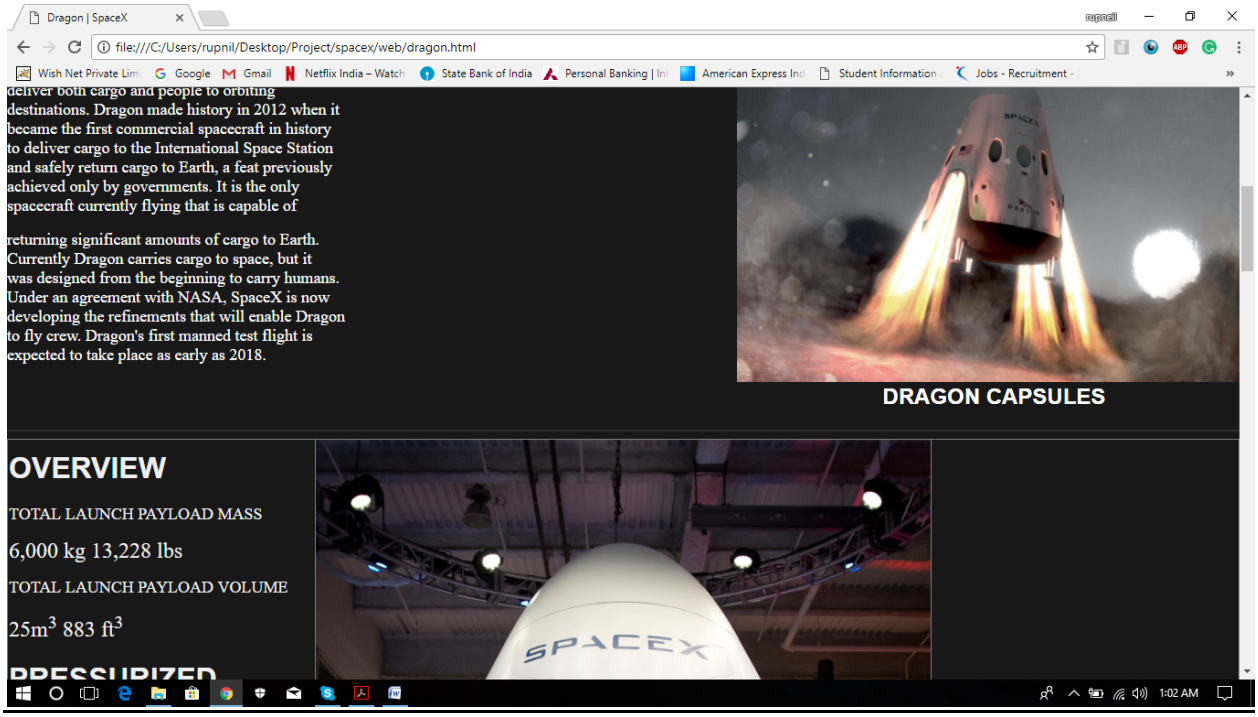

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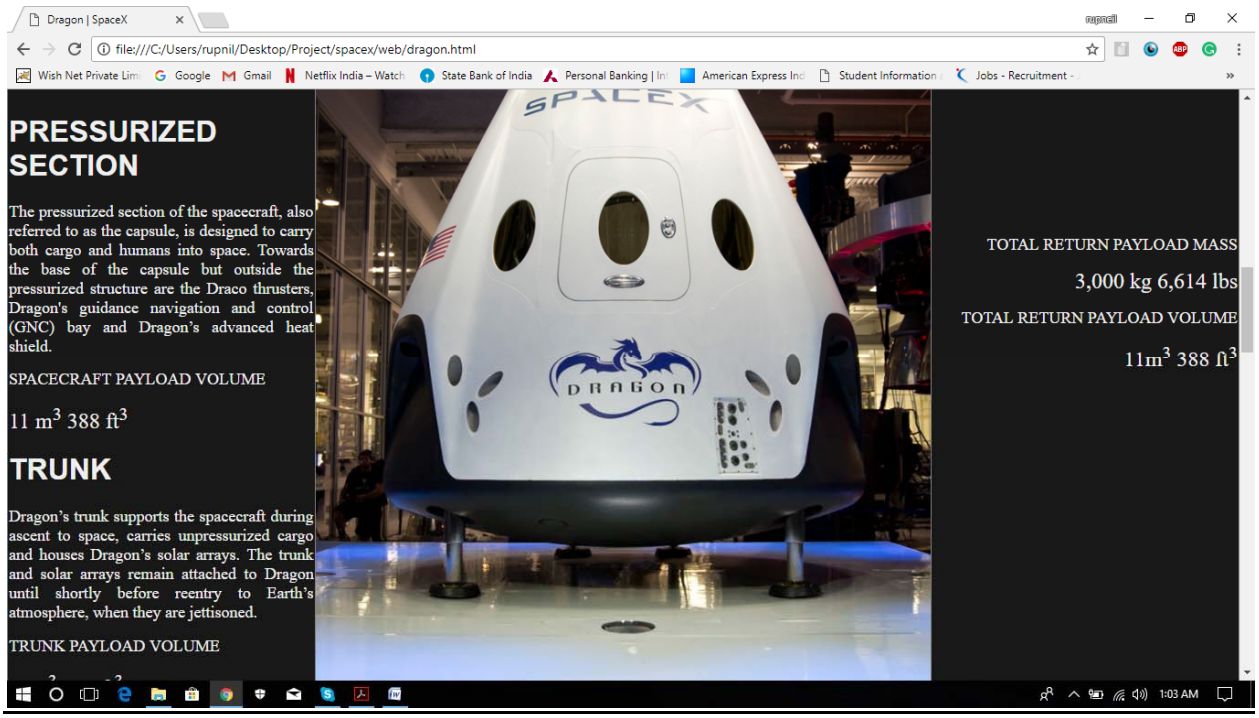
Dragon | SpaceX
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PRESSURIZED SECTION
The pressurized section of the spacecraft, also referred to as the capsule, is designed to carry both cargo and humans into space. Towards the base of the capsule but outside the pressurized structure are the Draco thrusters, Dragon's guidance navigation and control (GNC) bay and Dragon's advanced heat shield.
SPACECRAFT PAYLOAD VOLUME
11 m3 388 ft3
TRUNK
Dragon's trunk supports the spacecraft during ascent to space, carries unpressurized cargo and houses Dragon's solar arrays. The trunk and solar arrays remain attached to Dragon until shortly before reentry to Earth's atmosphere, when they are jettisoned.
TRUNK PAYLOAD VOLUME
SPACEX
DRAGON
TOTAL RETURN PAYLOAD MASS
3,000 kg 6,614 lbs
TOTAL RETURN PAYLOAD VOLUME
11m3 388 ft3
1:03 AM

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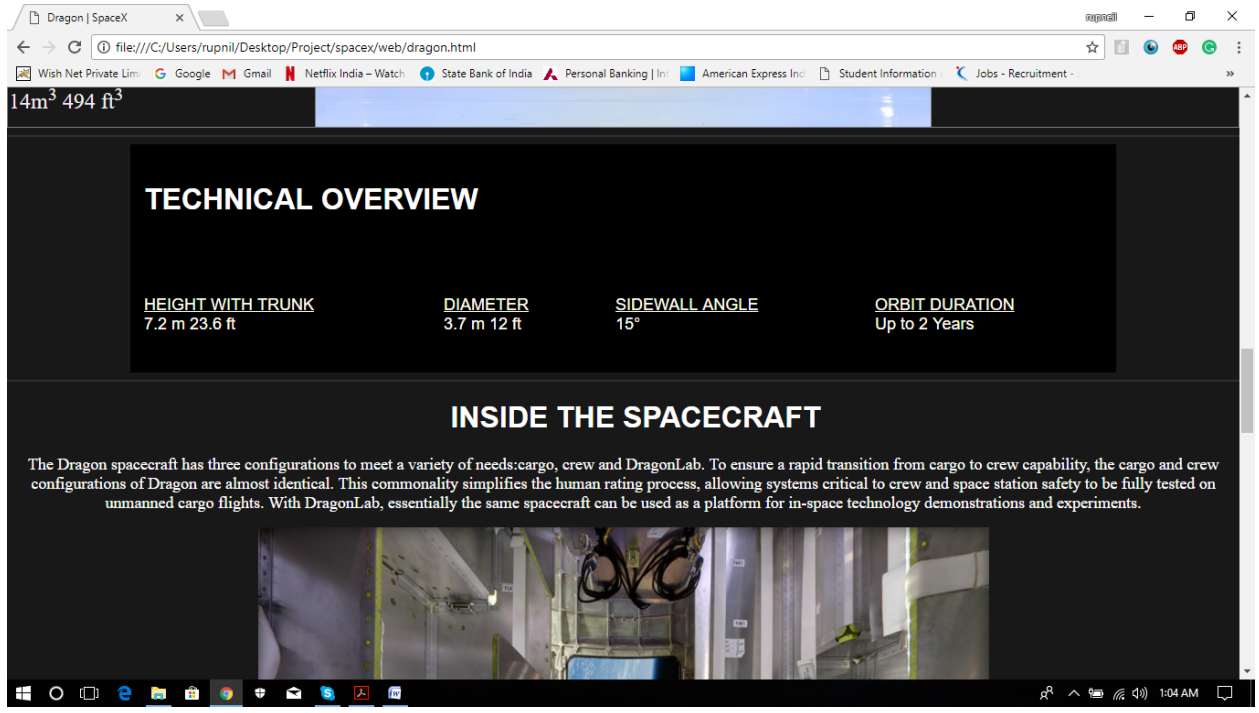
Dragon | SpaceX
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14m3 494 ft3
TECHNICAL OVERVIEW
HEIGHT WITH TRUNK
7.2 m 23.6 ft
DIAMETER
3.7 m 12 ft
SIDEWALL ANGLE
15°
ORBIT DURATION
Up to 2 Years
INSIDE THE SPACECRAFT
The Dragon spacecraft has three configurations to meet a variety of needs:cargo, crew and DragonLab. To ensure a rapid transition from cargo to crew capability, the cargo and crew configurations of Dragon are almost identical. This commonality simplifies the human rating process, allowing systems critical to crew and space station safety to be fully tested on unmanned cargo flights. With DragonLab, essentially the same spacecraft can be used as a platform for in-space technology demonstrations and experiments.
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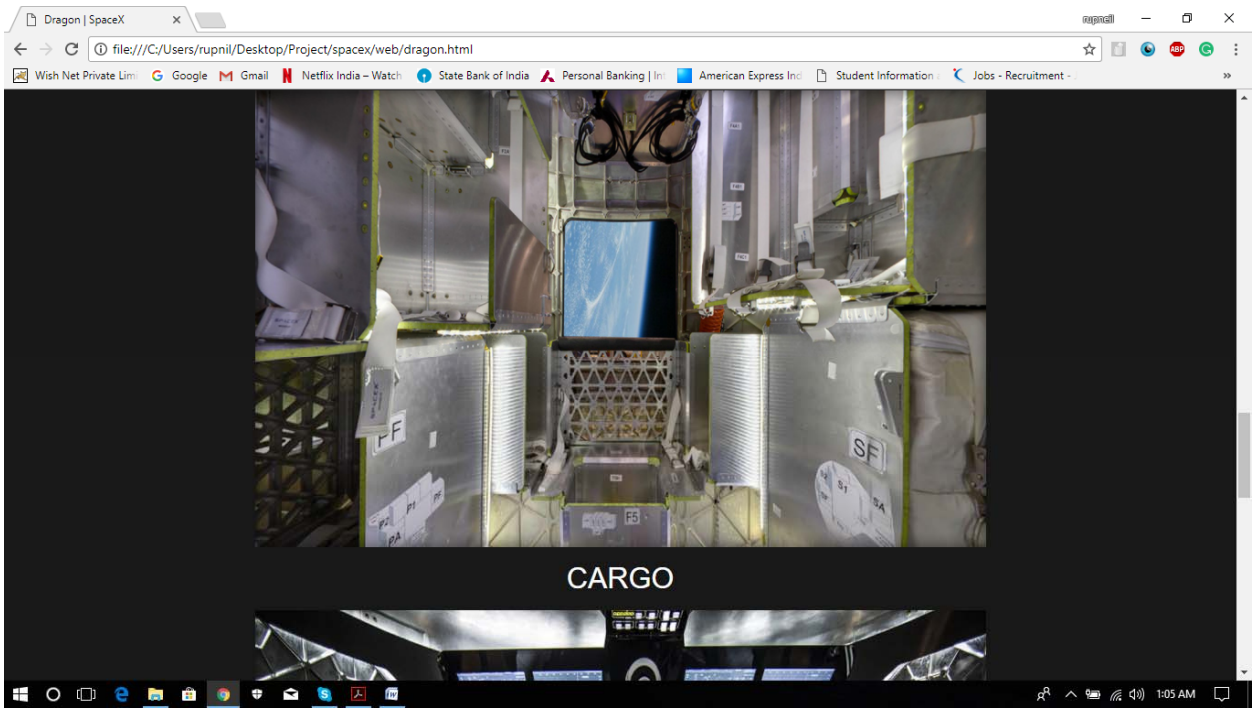
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CARGO
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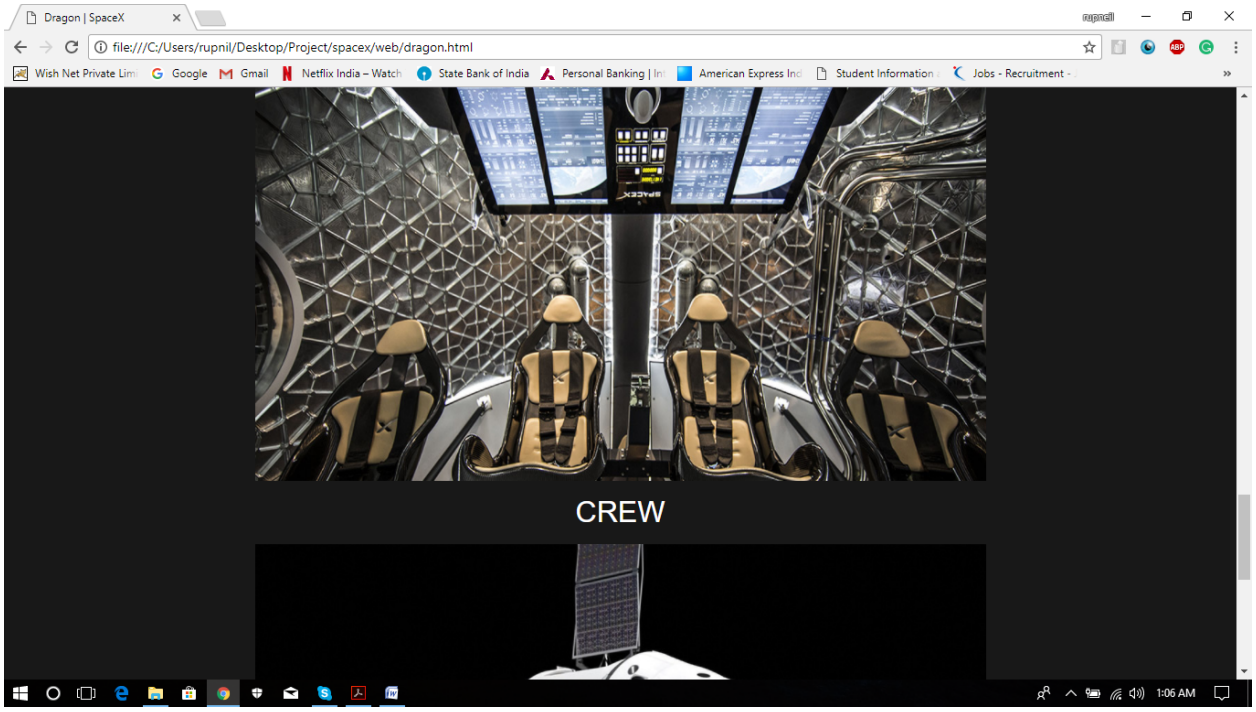
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CREW
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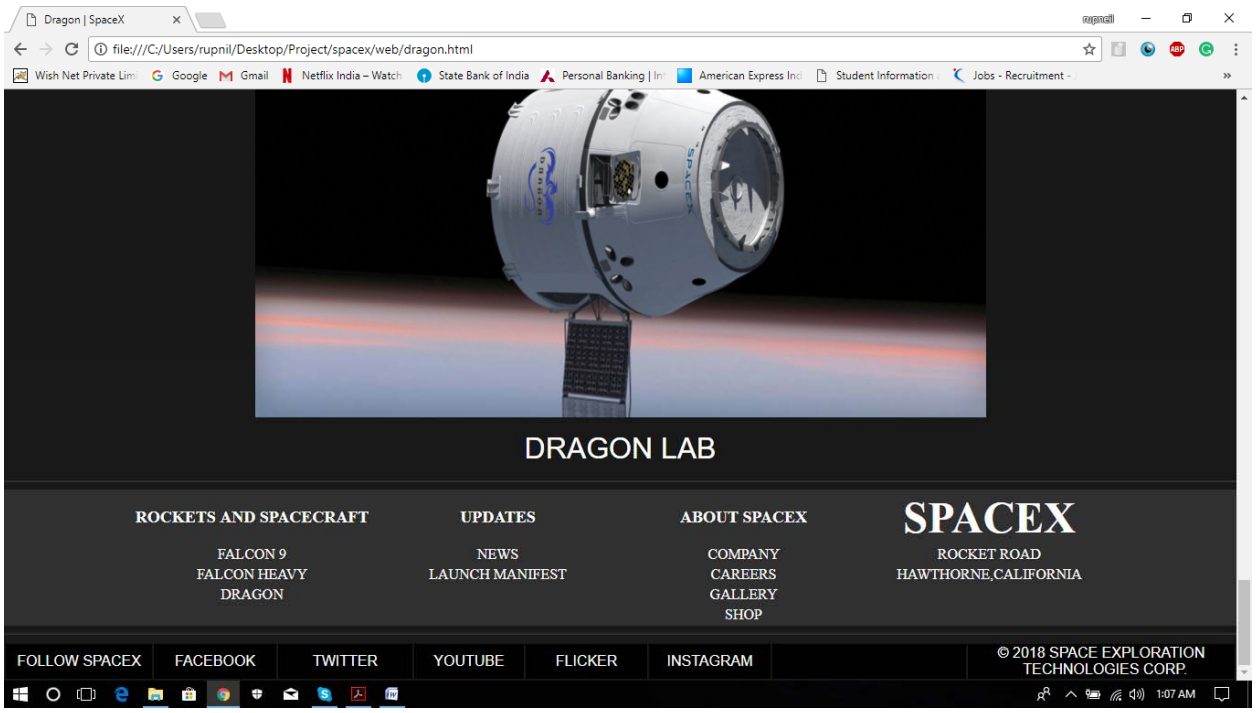
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State Bank of India
Personal Banking | In
American Express Inc
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DRAGON LAB
ROCKETS AND SPACECRAFT
FALCON 9
FALCON HEAVY
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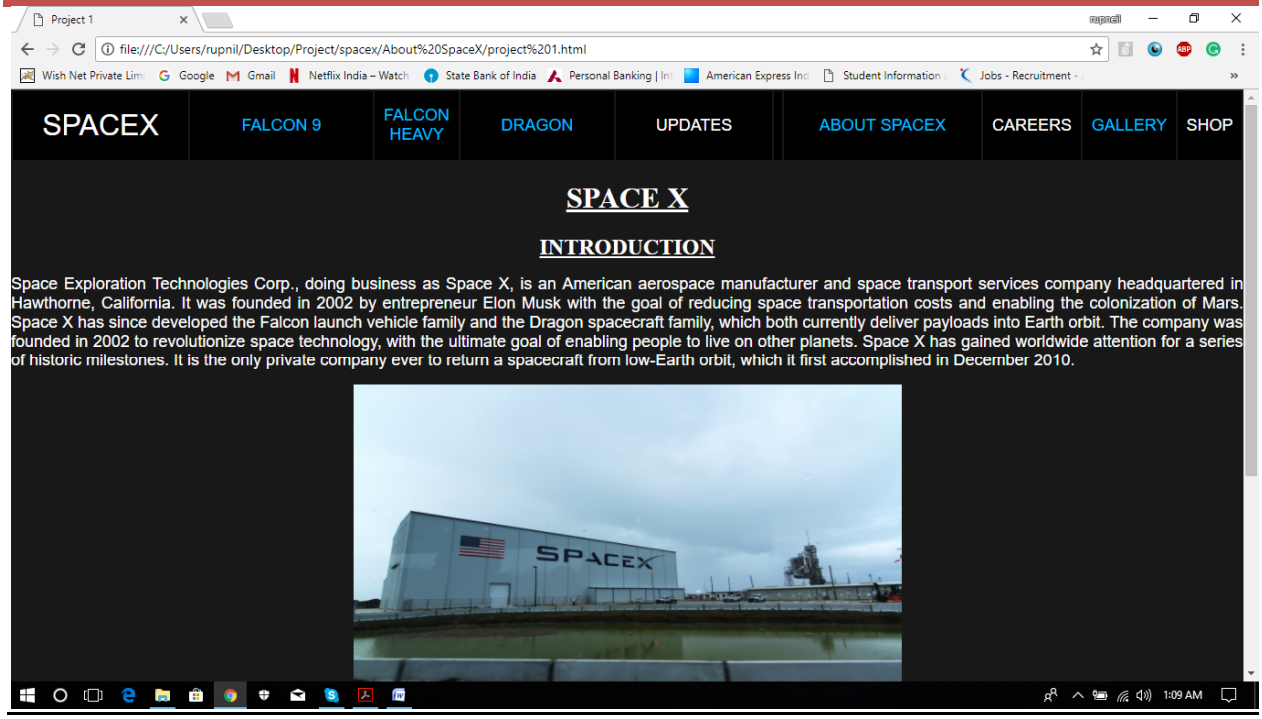

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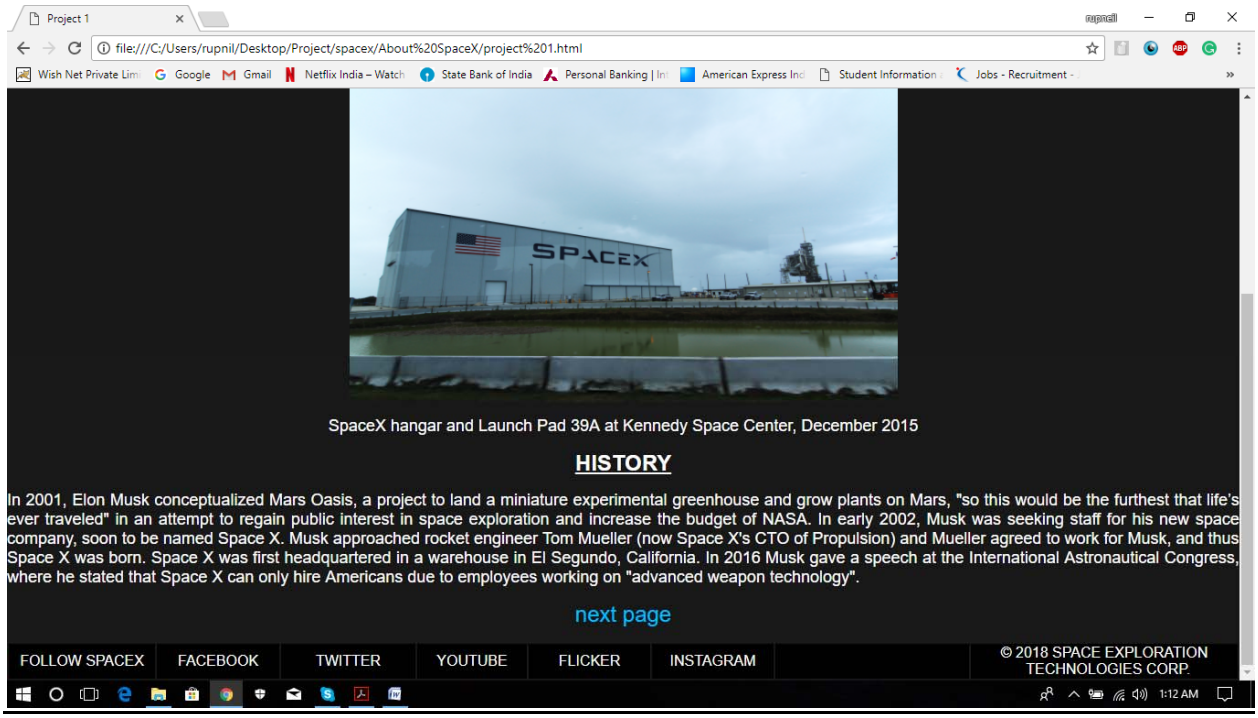

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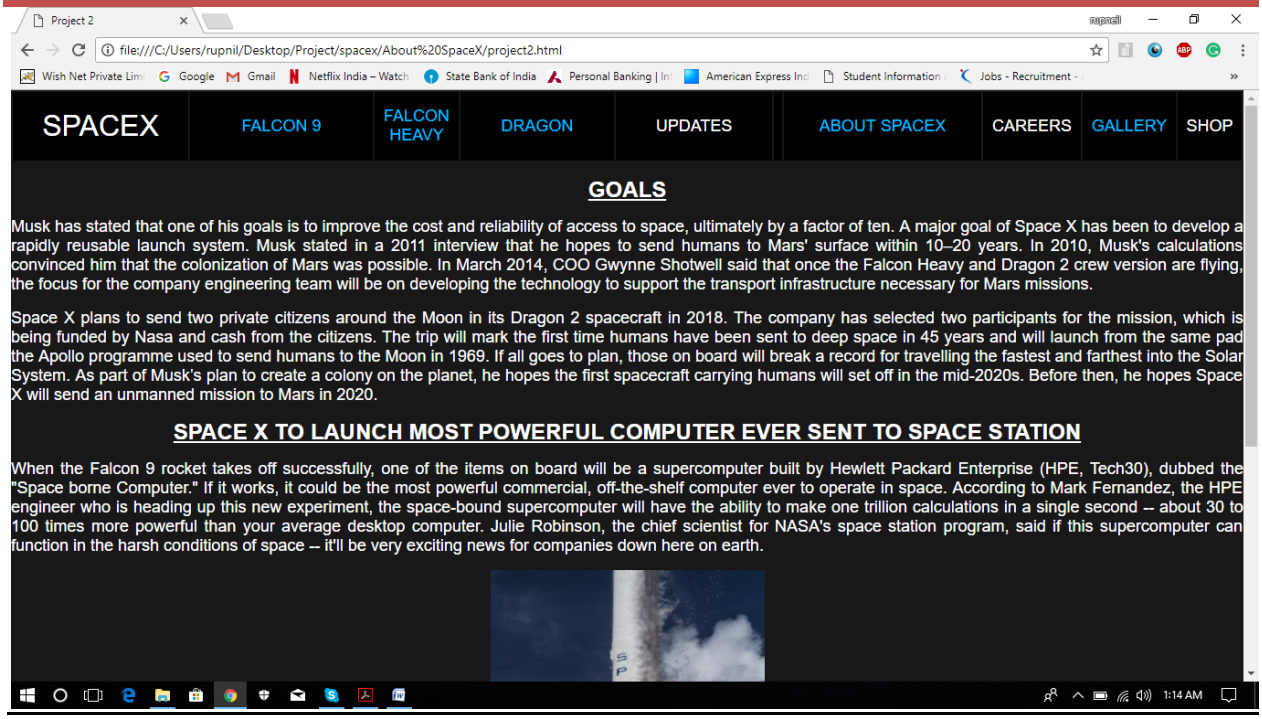

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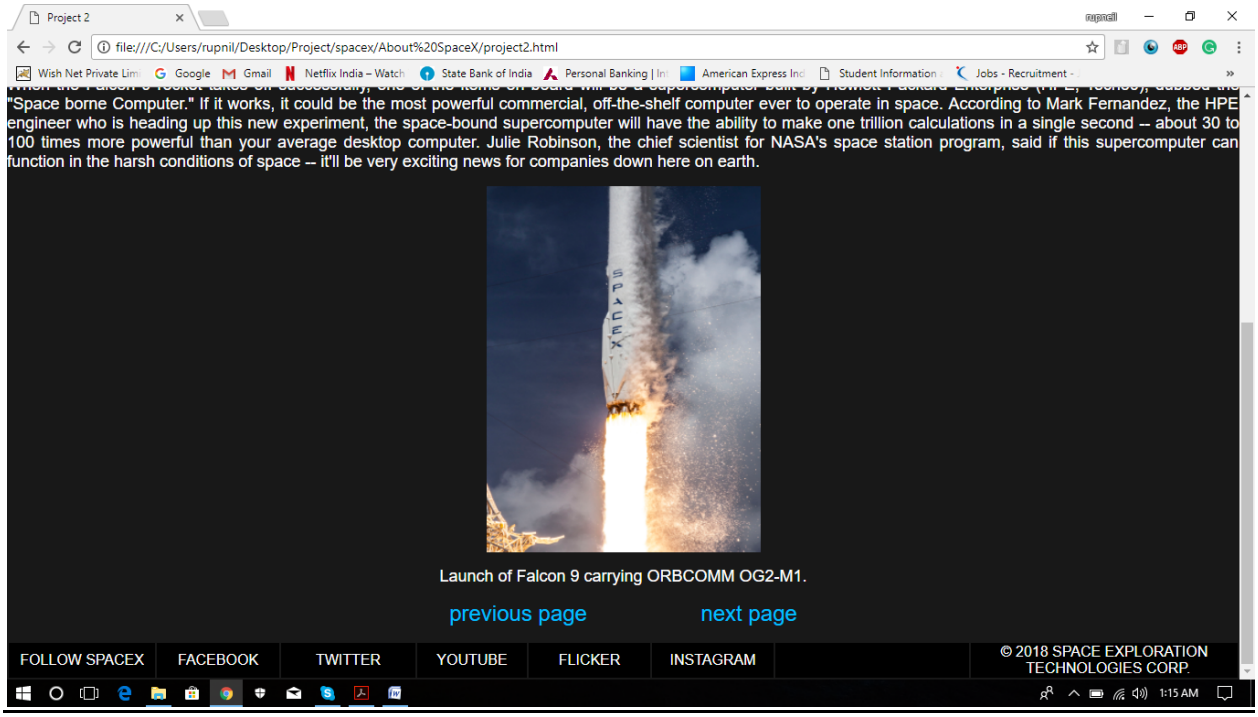

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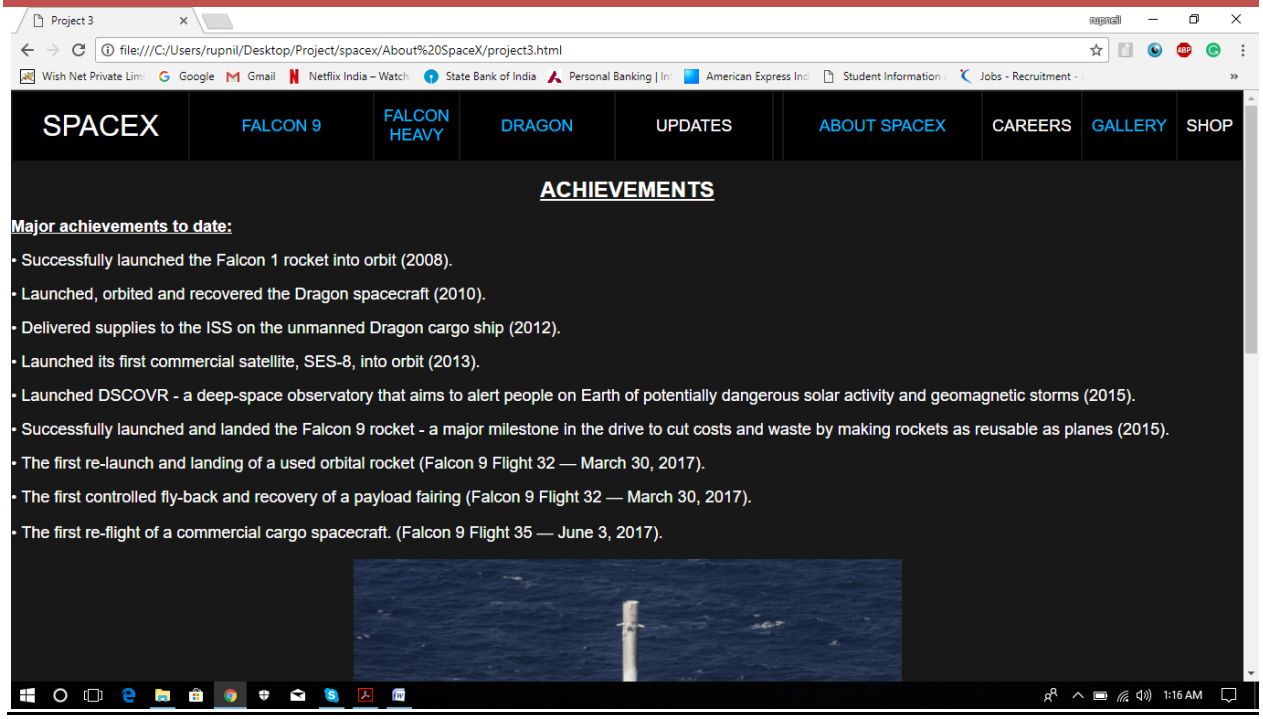

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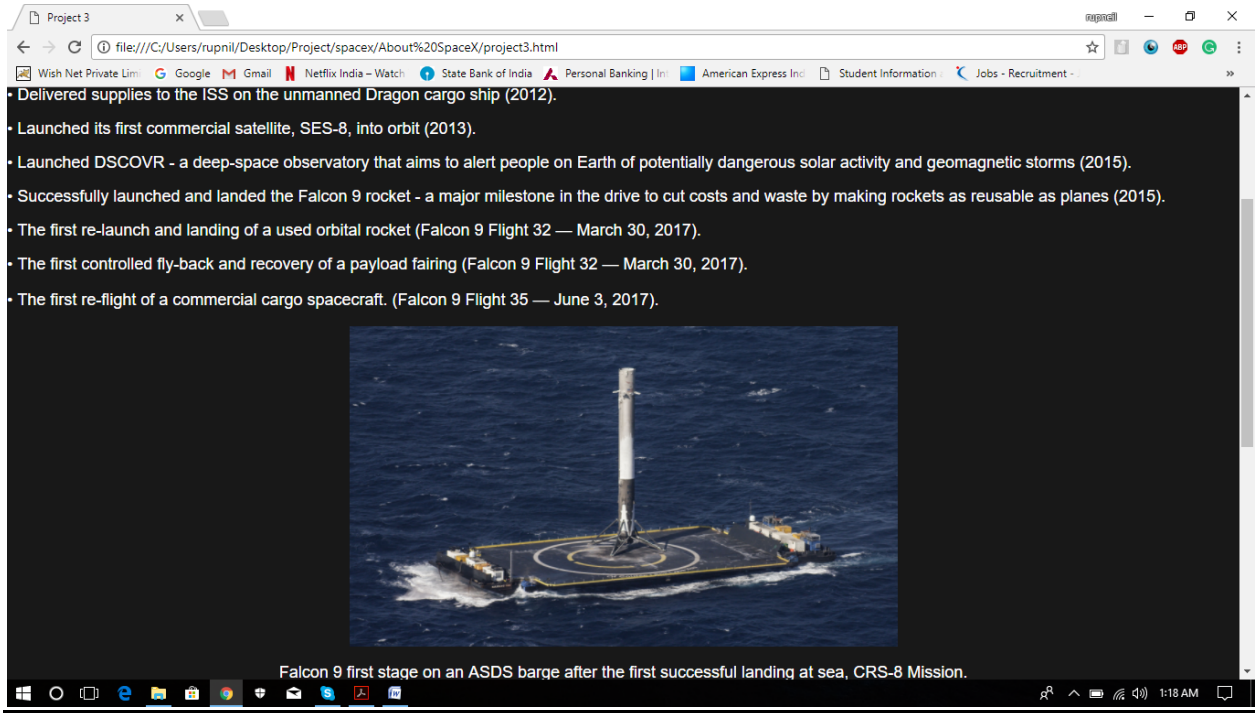

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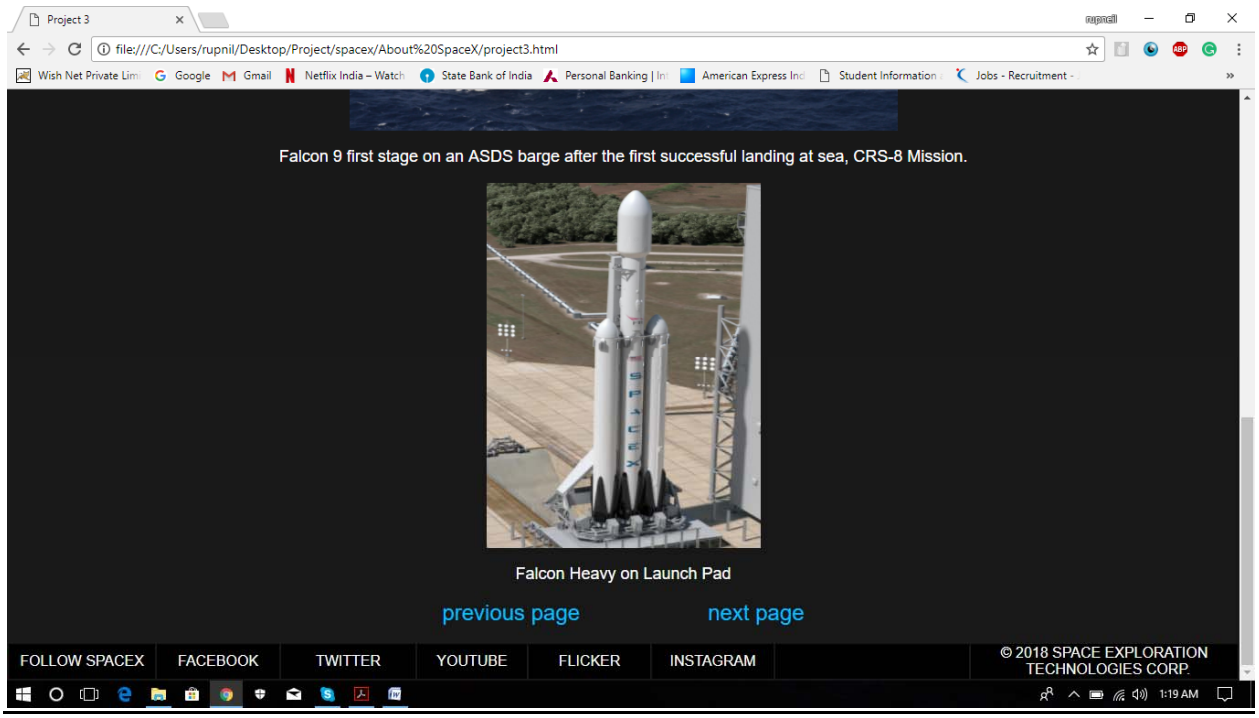
Project 3
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Falcon 9 first stage on an ASDS barge after the first successful landing at sea, CRS-8 Mission.
Falcon Heavy on Launch Pad
previous page
next page
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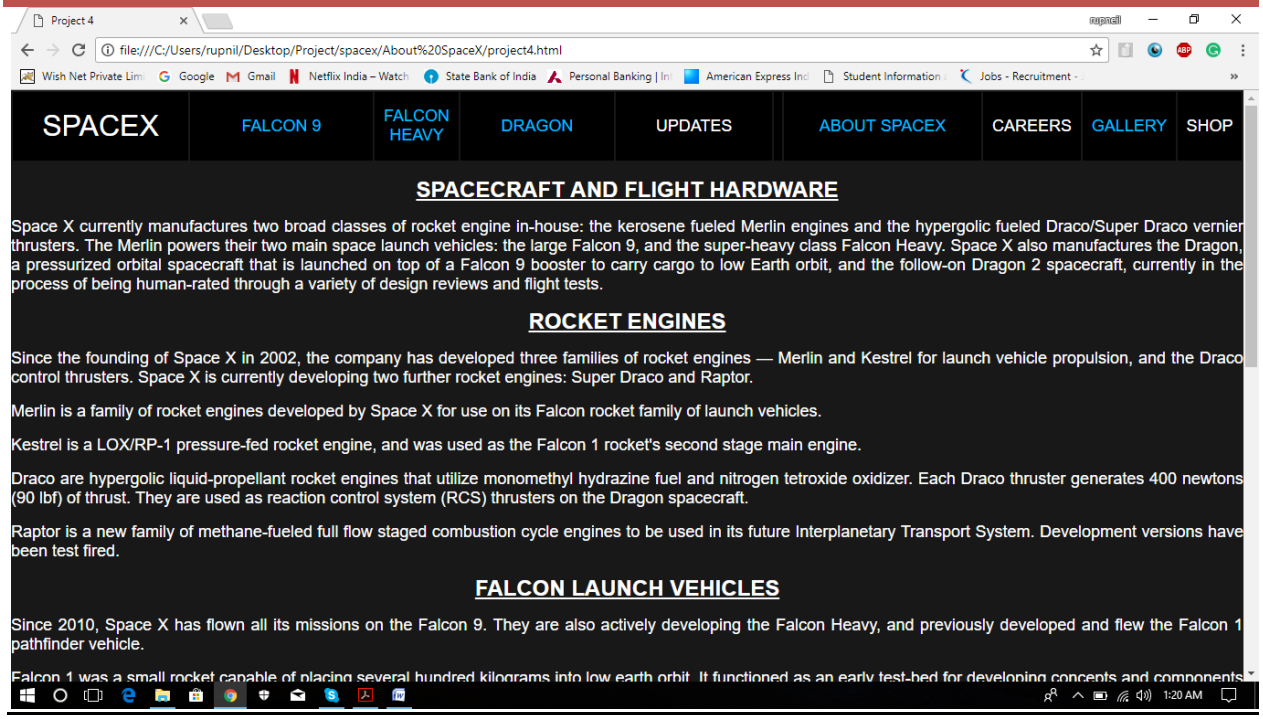

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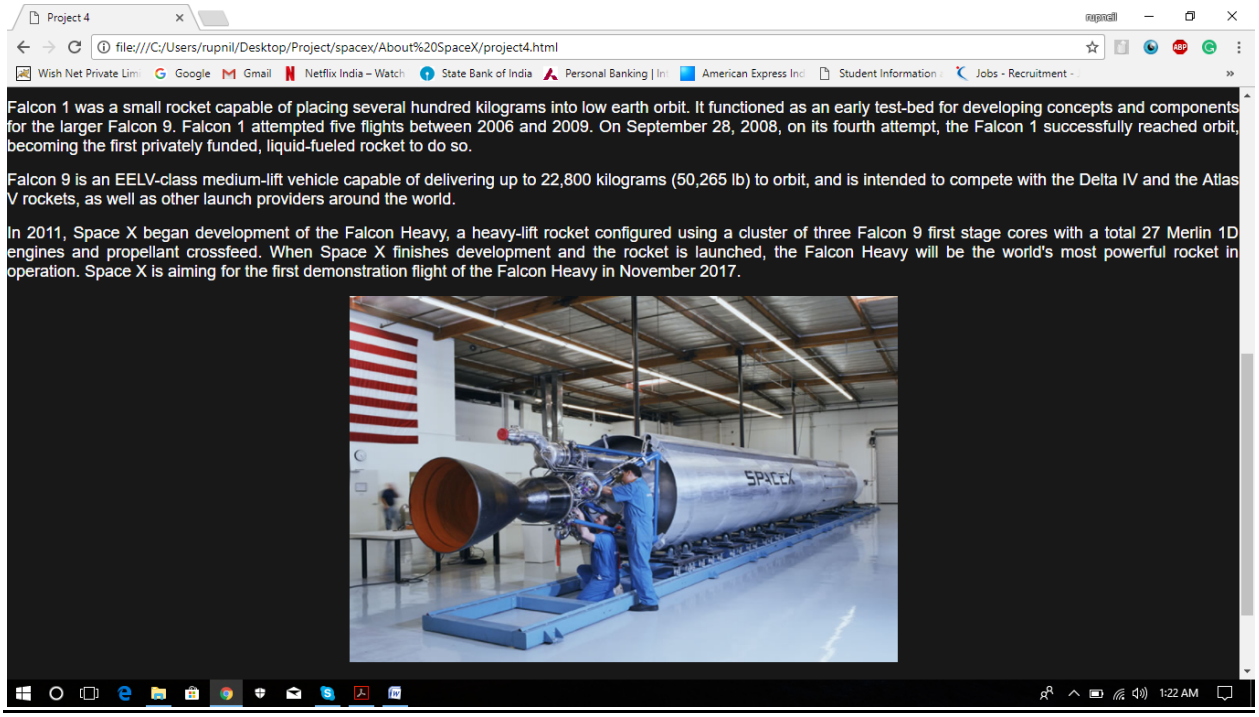

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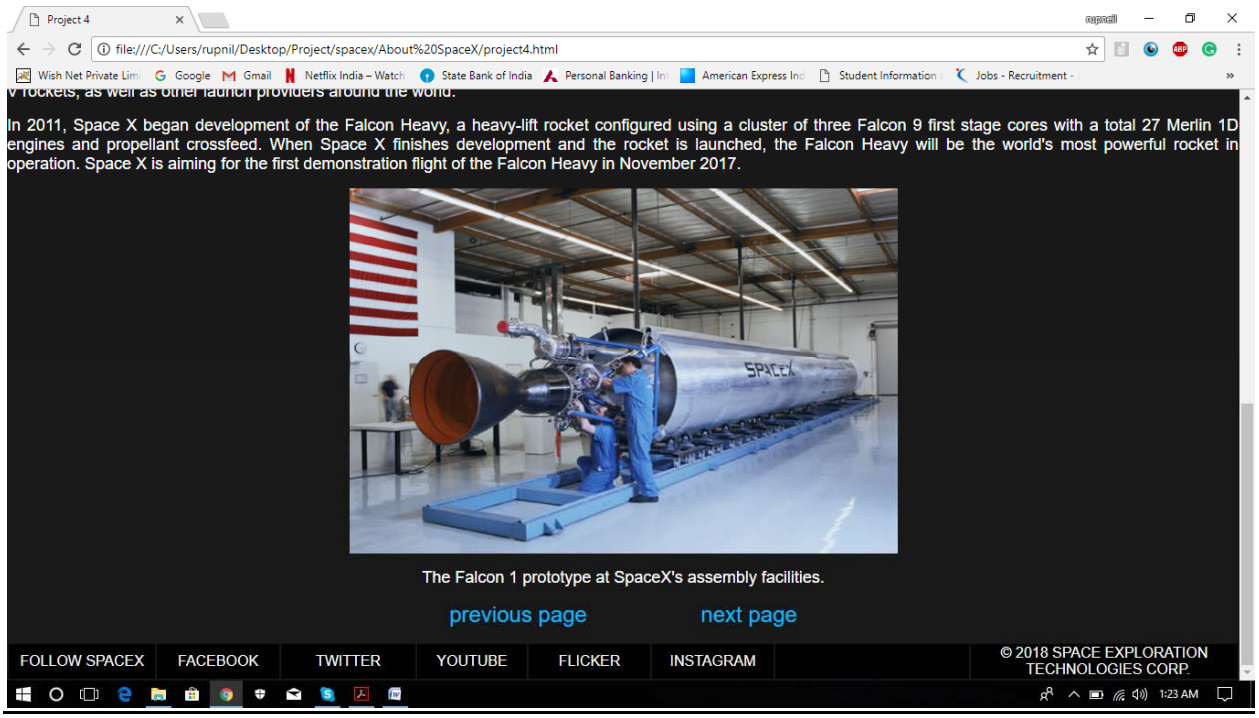
Project 4
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State Bank of India
Personal Banking | In
American Express Inc
Student Information
Jobs - Recruitment -
In 2011, Space X began development of the Falcon Heavy, a heavy-lift rocket configured using a cluster of three Falcon 9 first stage cores with a total 27 Merlin 1D engines and propellant crossfeed. When Space X finishes development and the rocket is launched, the Falcon Heavy will be the world's most powerful rocket in operation. Space X is aiming for the first demonstration flight of the Falcon Heavy in November 2017.
SPACEX
The Falcon 1 prototype at SpaceX's assembly facilities.
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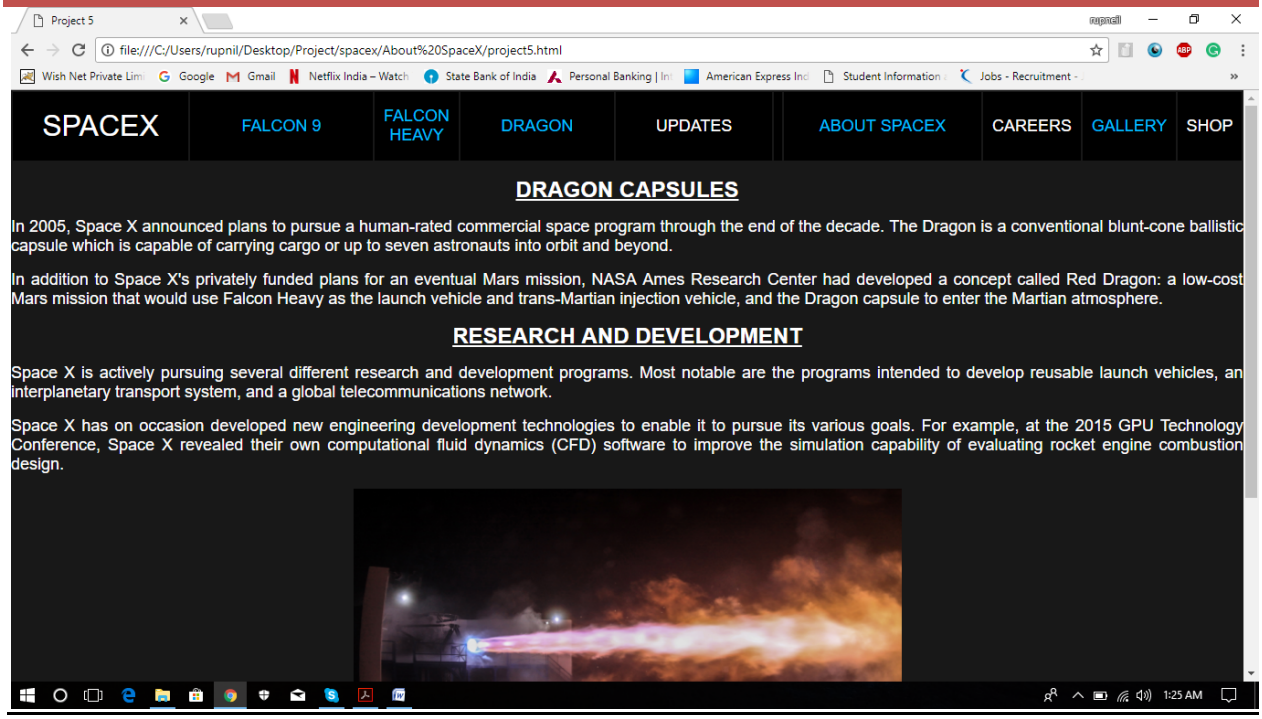

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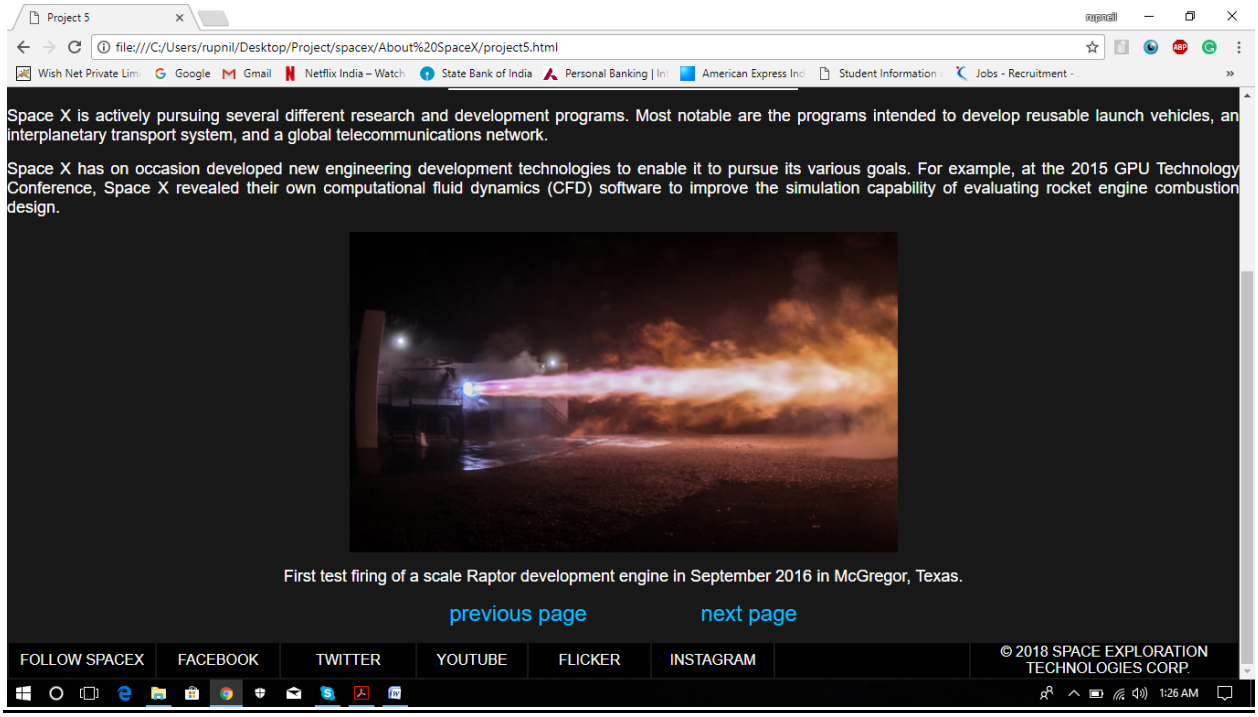

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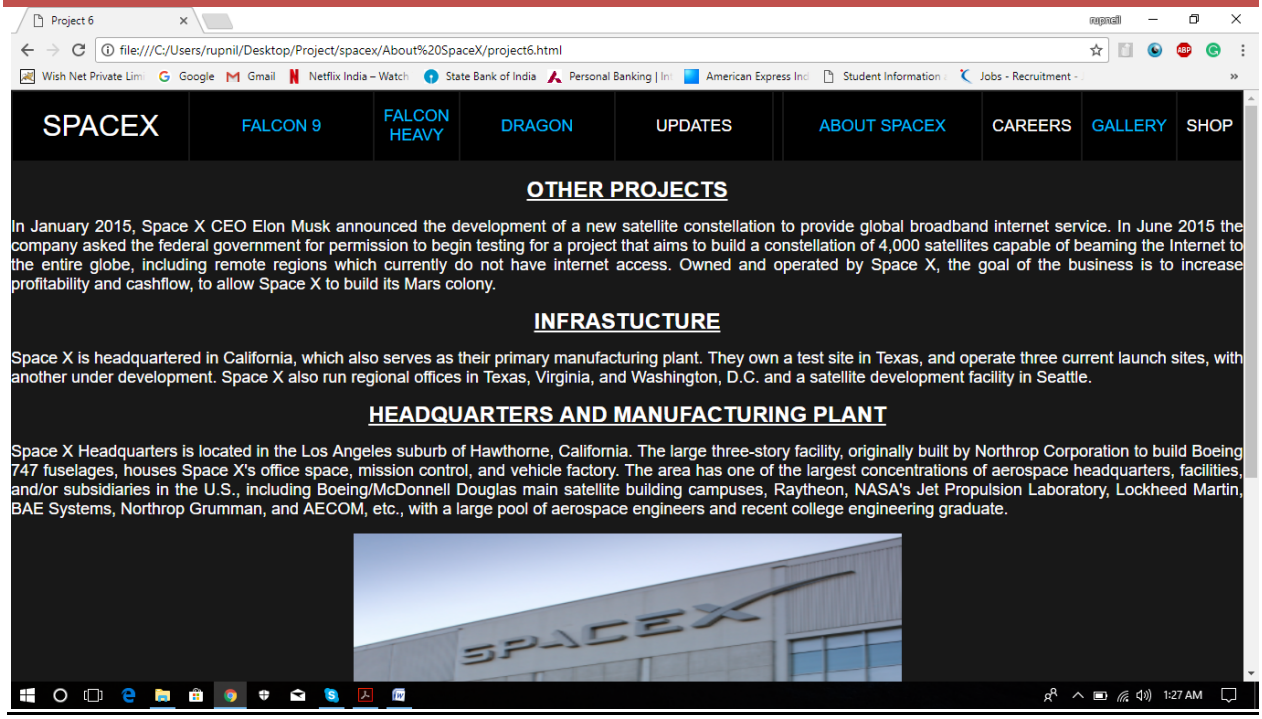

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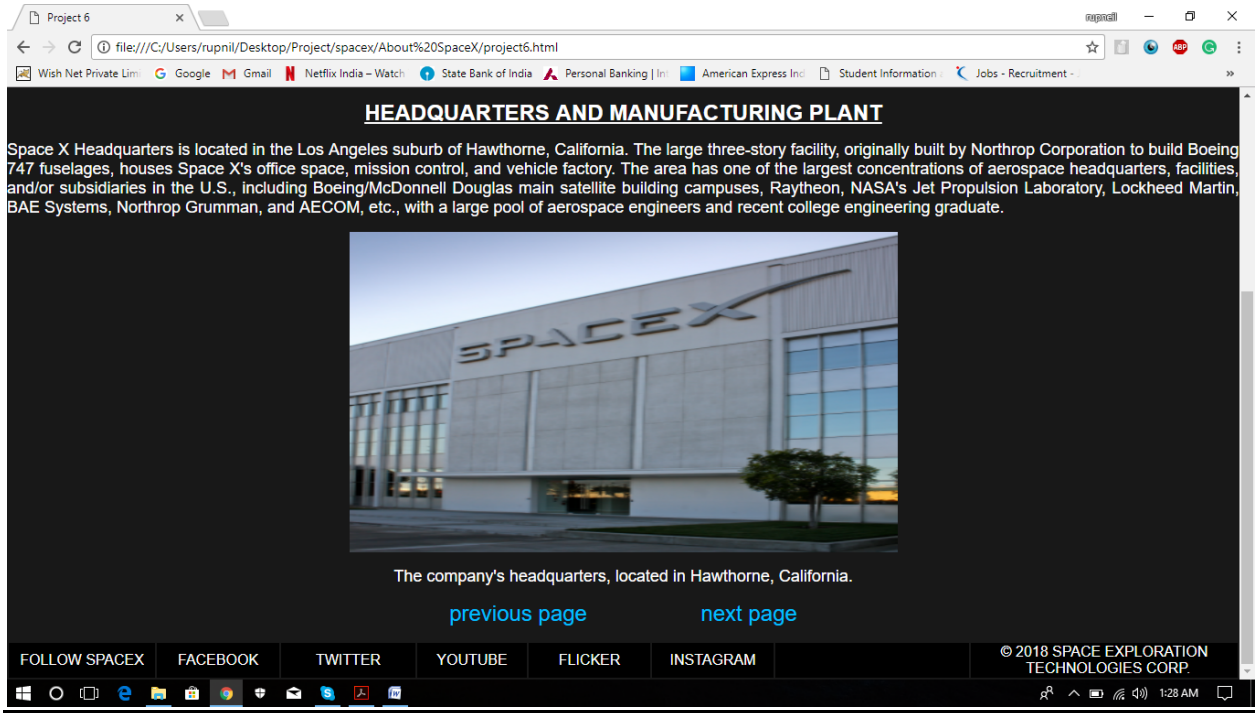

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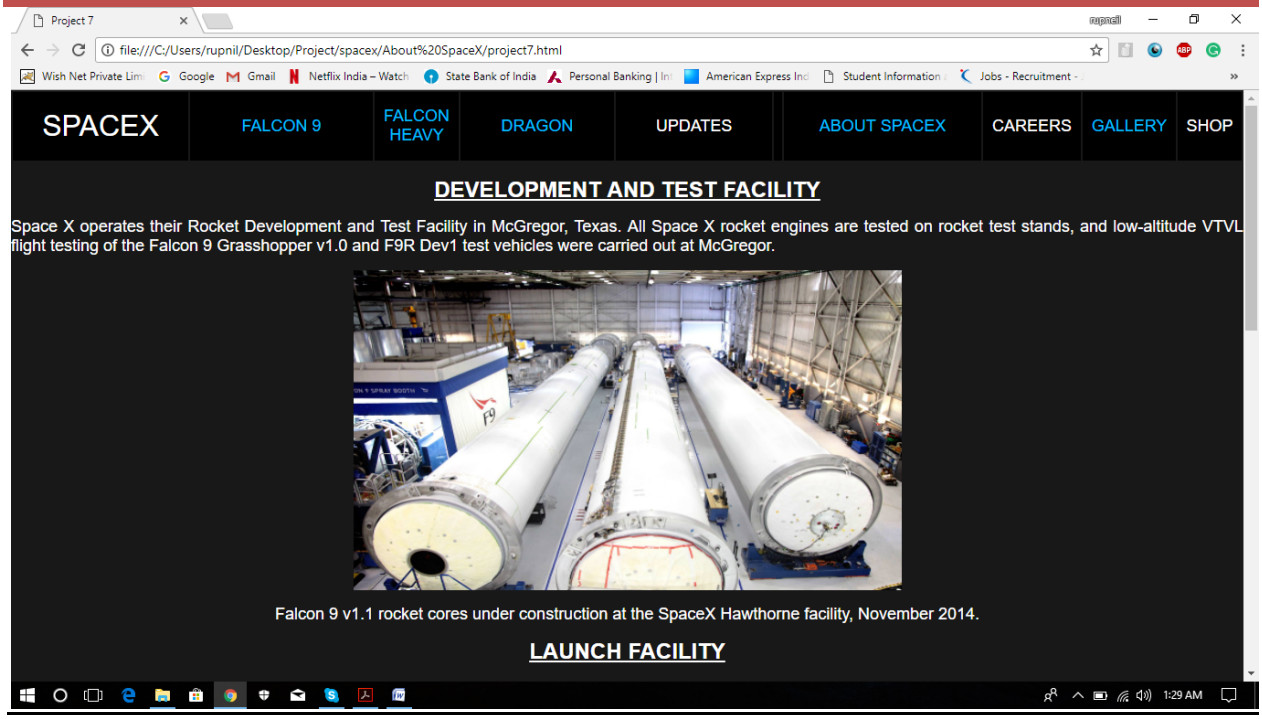

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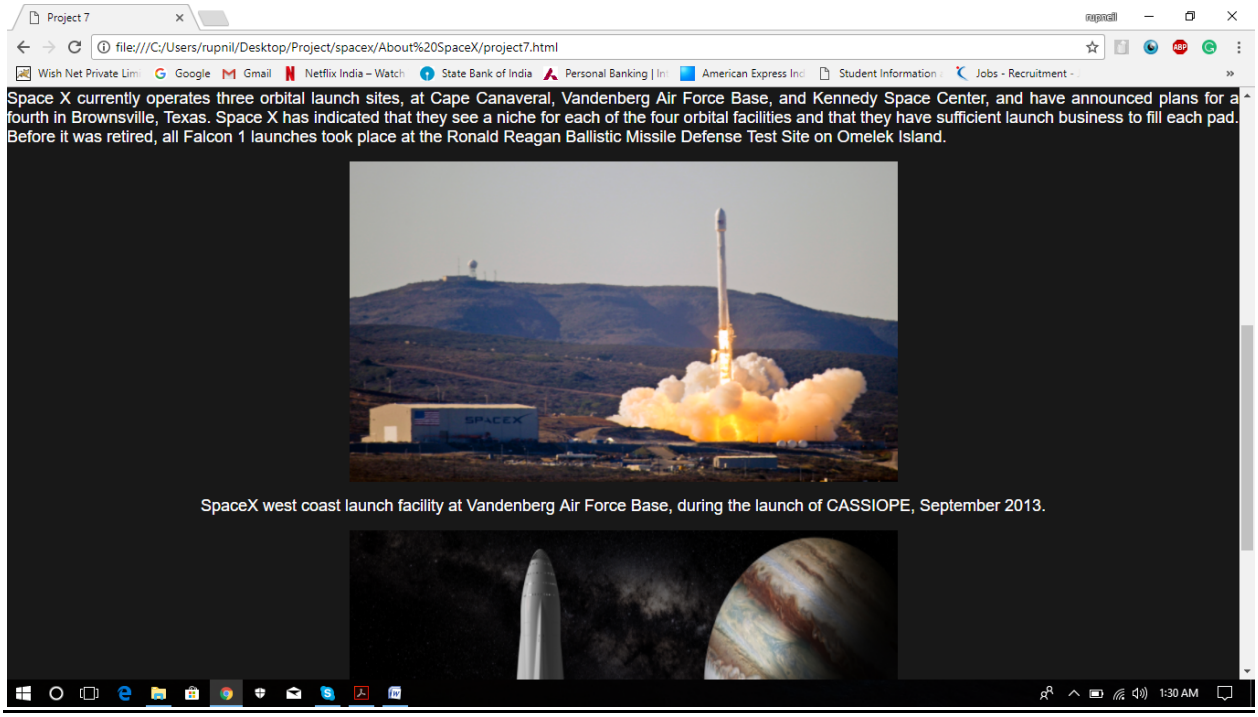

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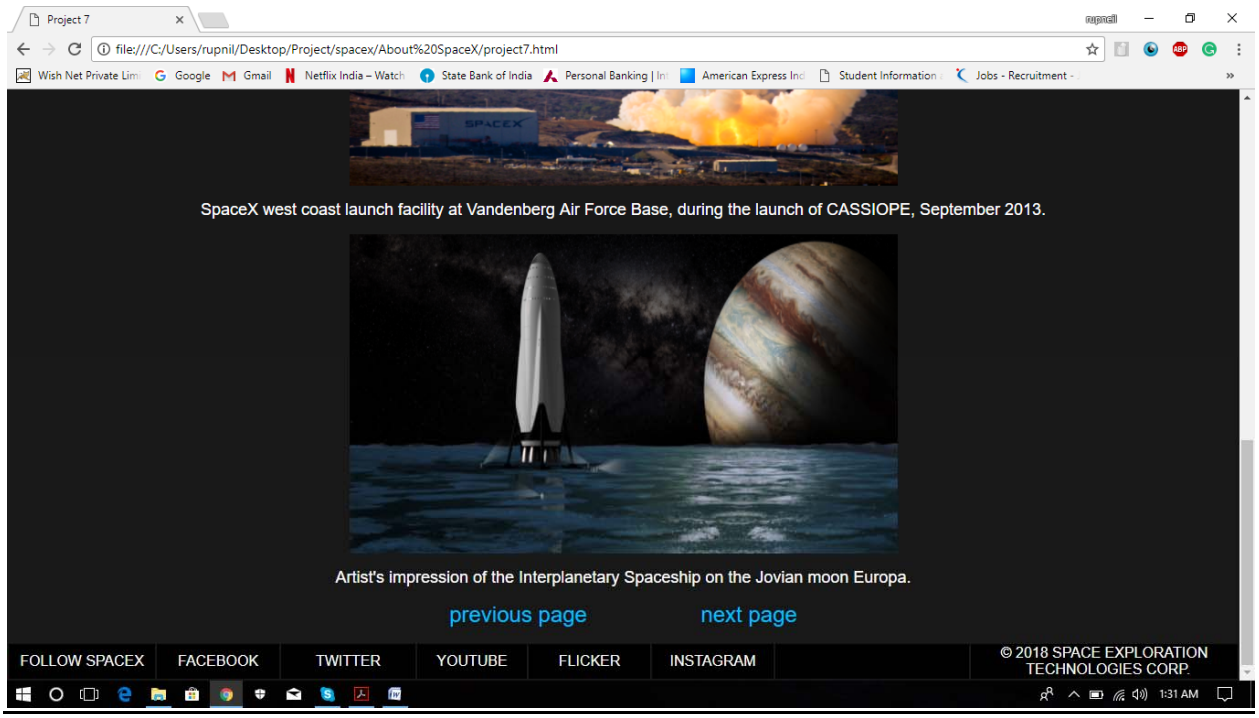
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Google
Gmail
Netflix India – Watch
State Bank of India
Personal Banking | In
American Express Inc
Student Information
Jobs - Recruitment -
SpaceX west coast launch facility at Vandenberg Air Force Base, during the launch of CASSIOPE, September 2013.
Artist's impression of the Interplanetary Spaceship on the Jovian moon Europa.
previous page
next page
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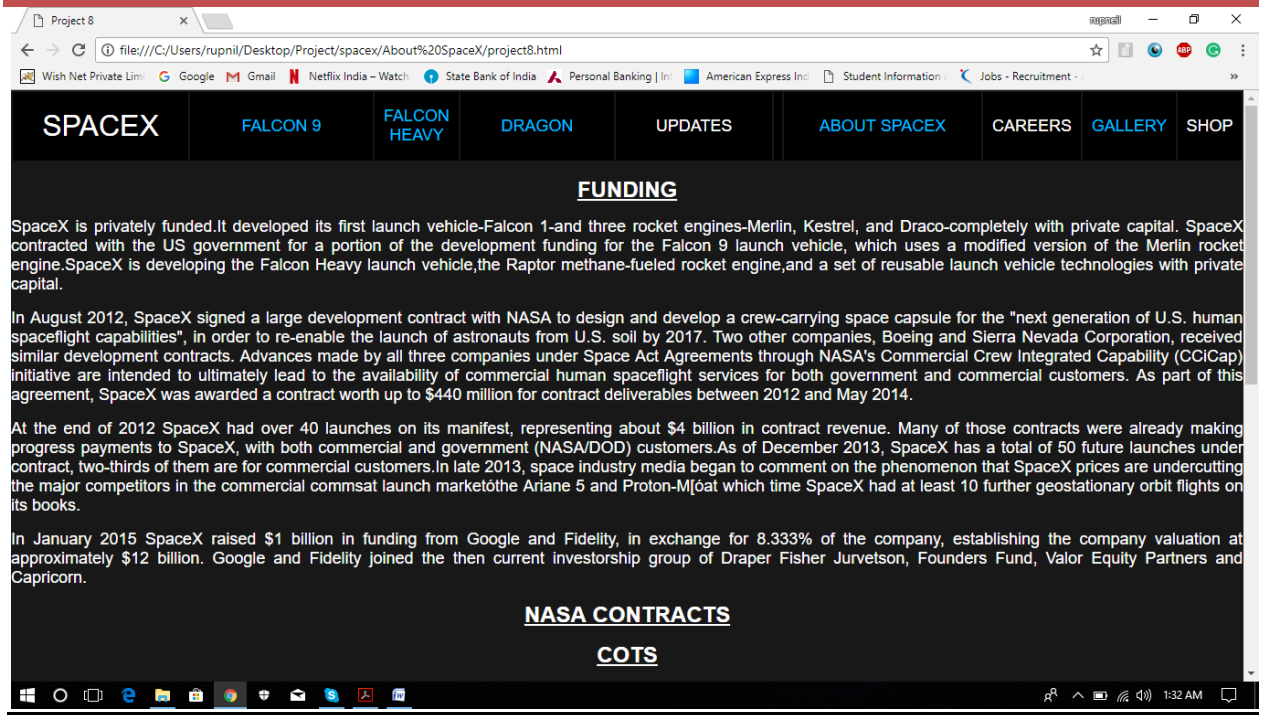
1:31 AM

project8.html



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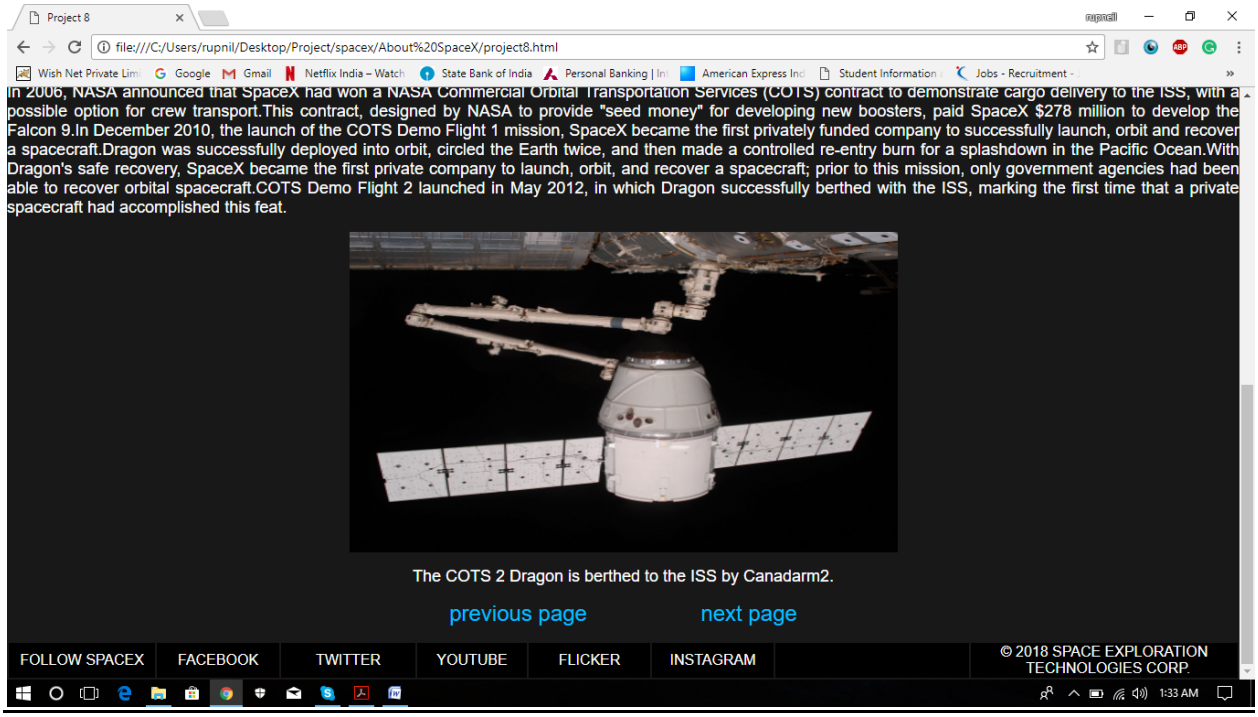

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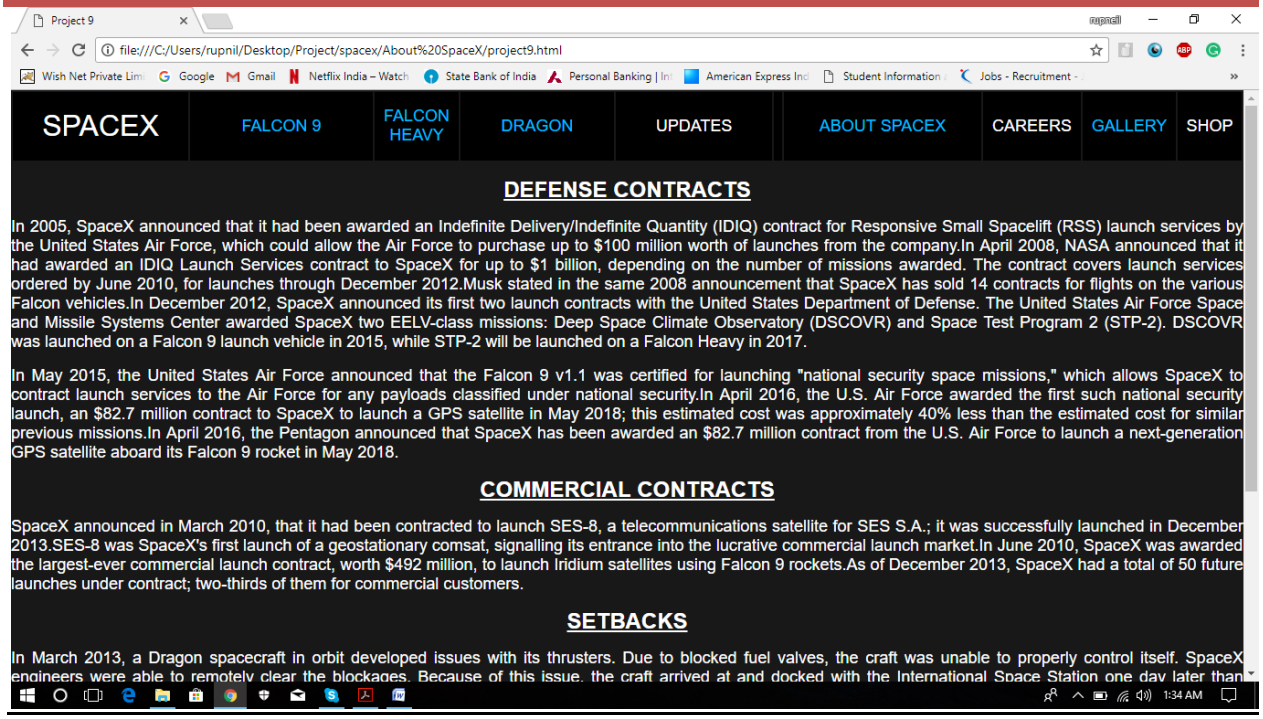

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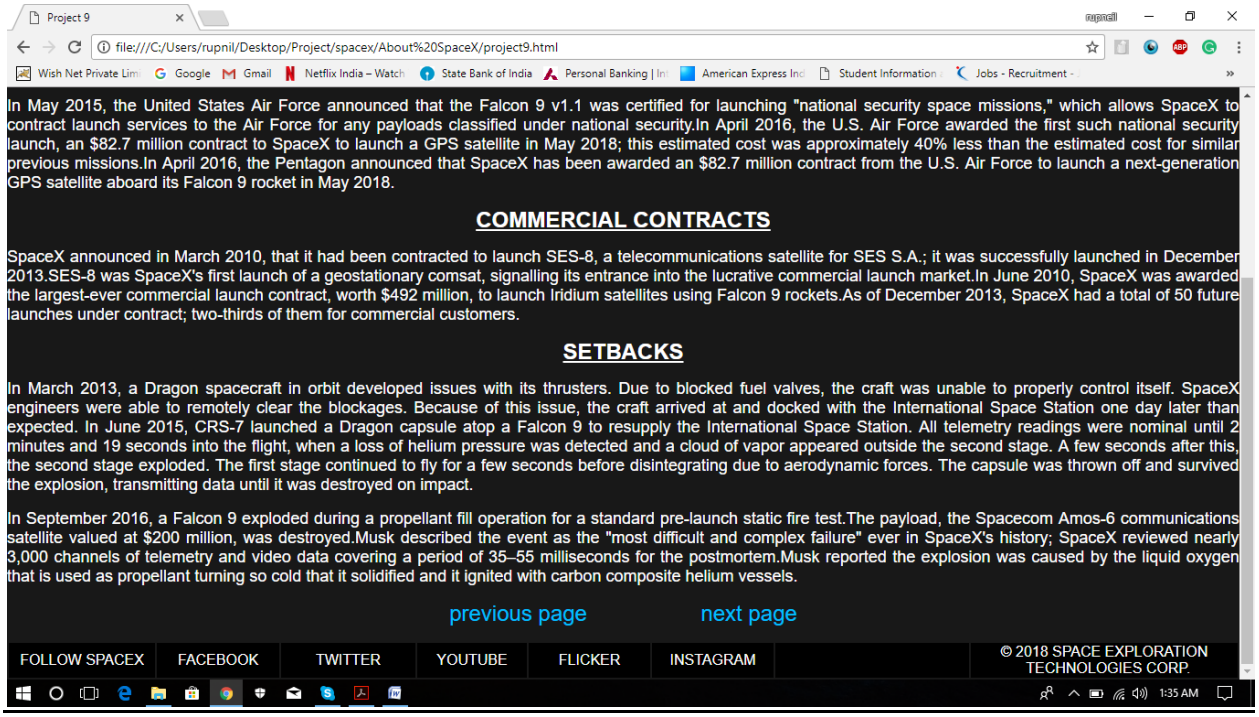

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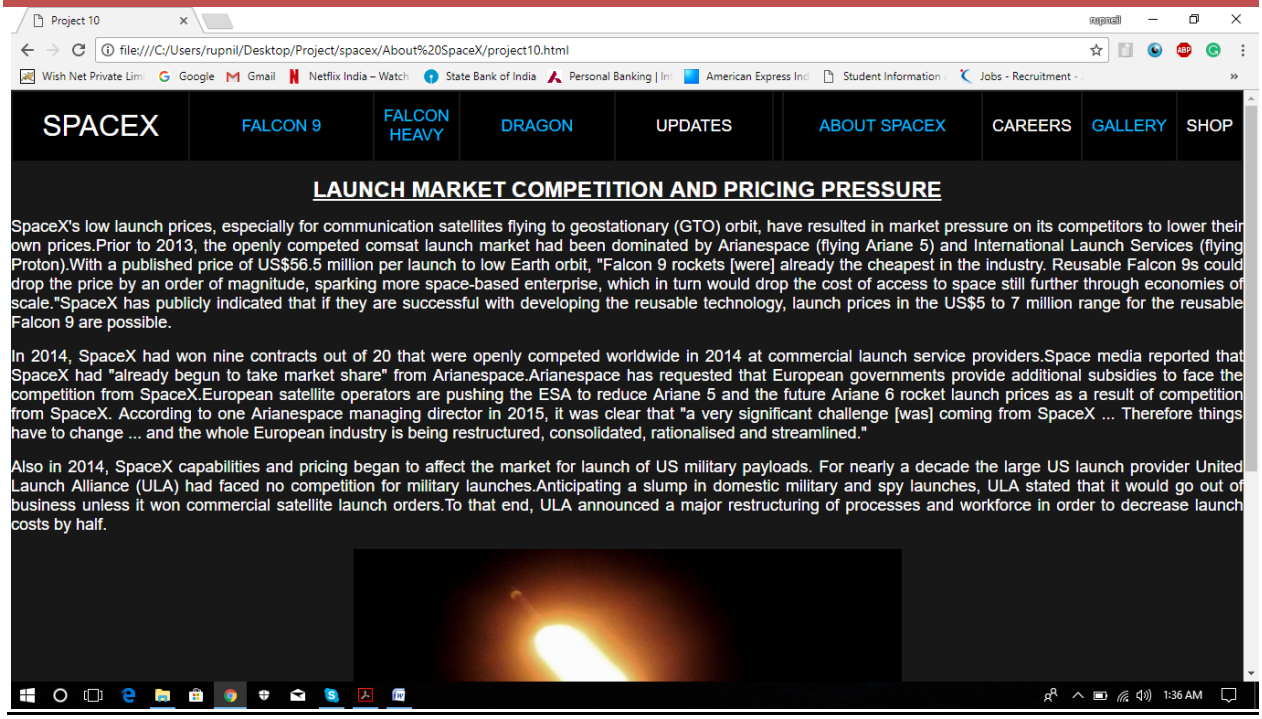

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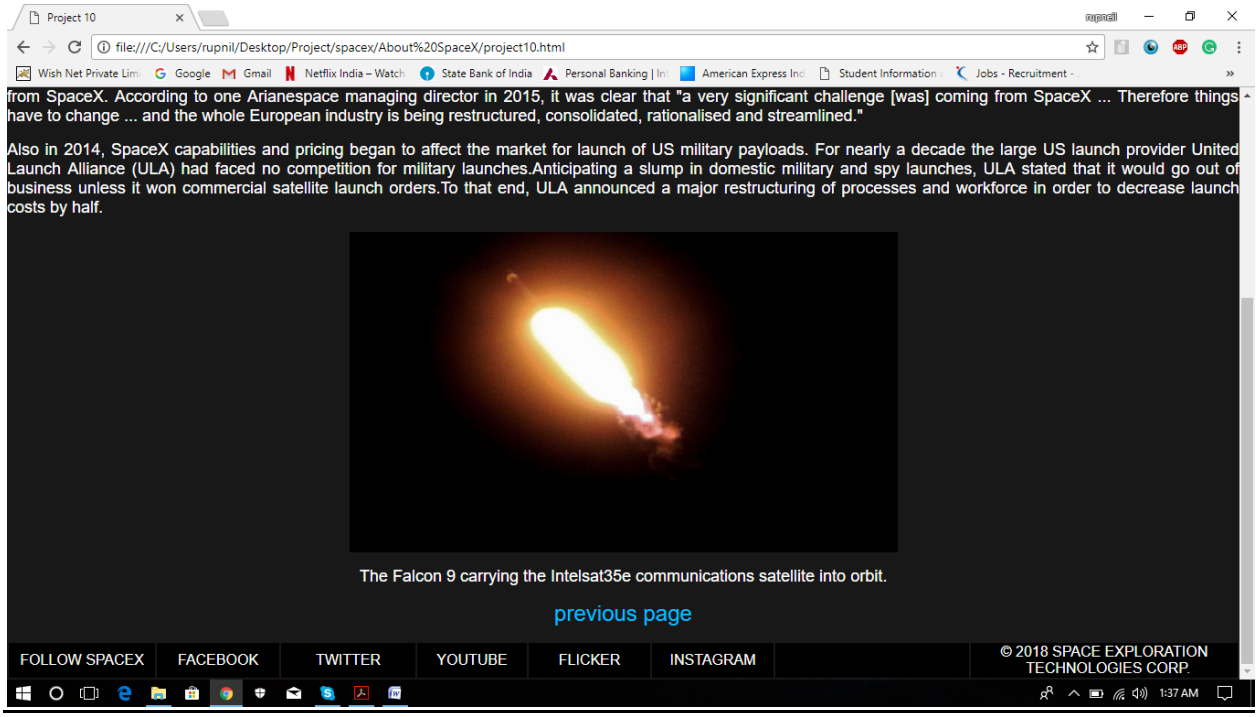

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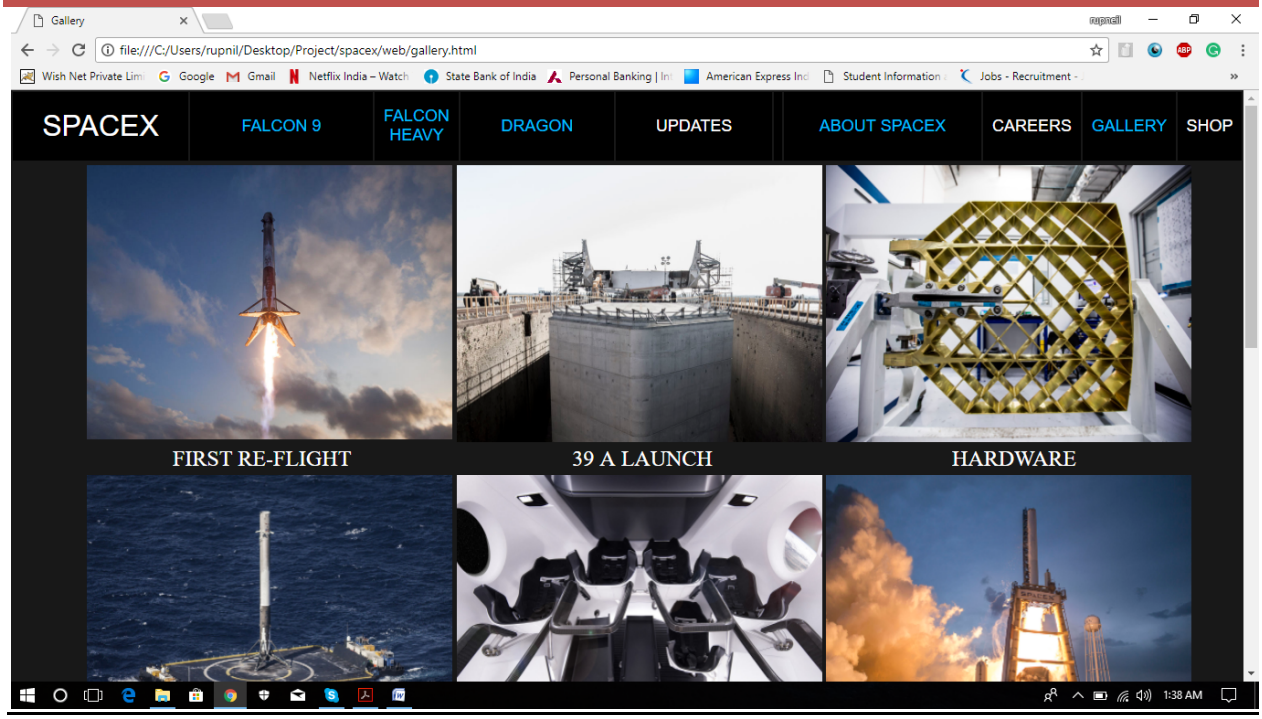

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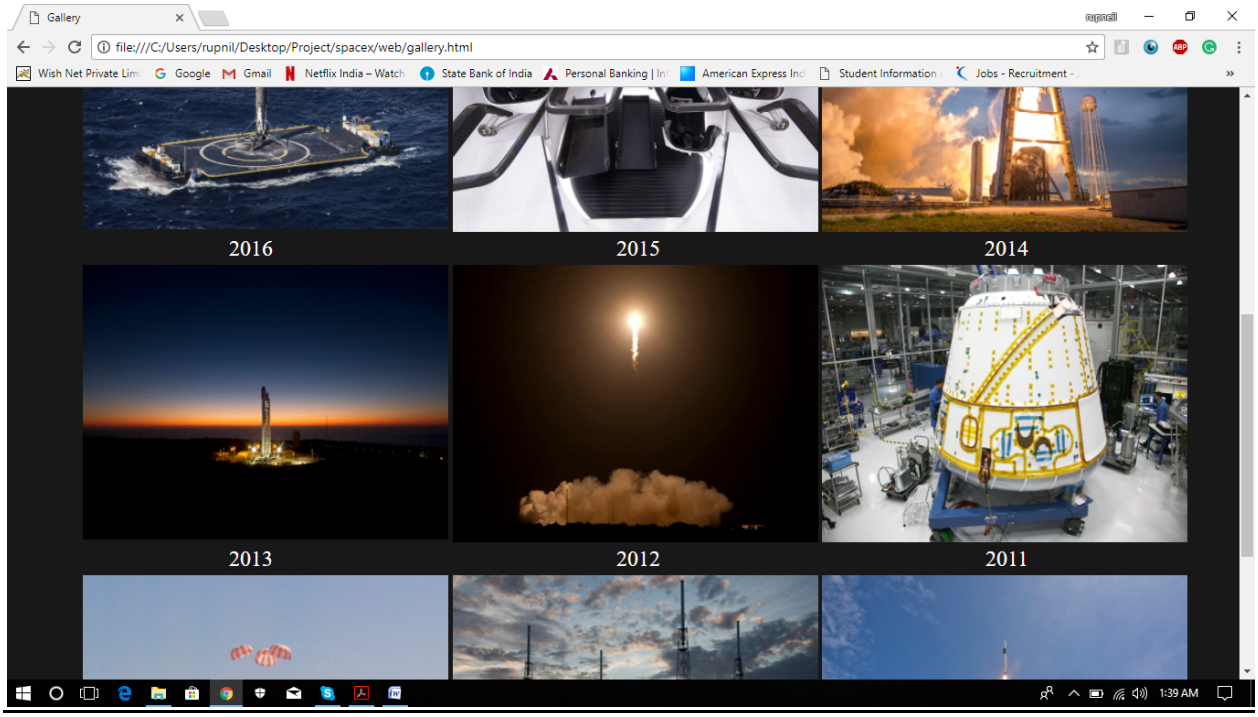

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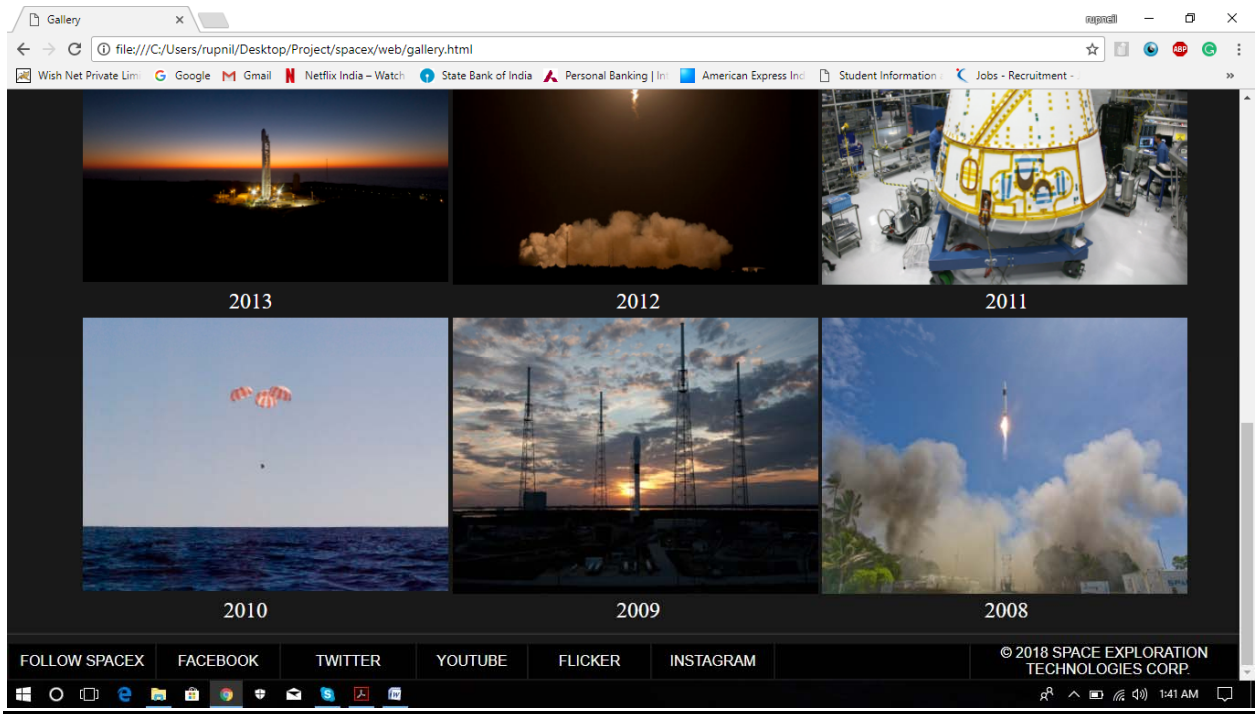
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Student Information
Jobs - Recruitment -
2013
2012
2011
2010
2009
2008
FOLLOW SPACEX
FACEBOOK
TWITTER
YOUTUBE
FLICKER
INSTAGRAM
© 2018 SPACE EXPLORATION TECHNOLOGIES CORP.
1:41 AM

SOURCE CODE

falcon 9.html

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          transition: all 0.6s;
          }
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          }
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href="../web\falcon 9.html">FALCON 9</a></font></td>

<td width="76"><center><font color="#FFFFFF" size="+1"><a
href="../web\falcon_heavy.html">FALCON HEAVY</a></font></center></td>

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<h1><font color="#FFFFFF">FALCON 9</font></h1>

<p align="justify"><font color="#FFFFFF" face="sans serif" size="4">Falcon 9 is a
two-stage rocket designed and manufactured by SpaceX for the reliable and safe
transport of satellites and the Dragon spacecraft into orbit. Falcon 9 is the first
orbital class rocket capable of reflight. SpaceX believes rocket reusability is the
key breakthrough needed to reduce the cost of access to space and enable people
to live on other planets.</font></p>

<p align="justify"><font color="#FFFFFF" face="sans serif" size="4">Falcon 9 was
designed from the ground up for maximum reliability. Falcon 9's simple two-stage
configuration minimizes the number of separation events -- and with nine first-
stage engines, it can safely complete its mission even in the event of an engine
shutdown.</font></p>

</td>
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Falcon 9 made history in 2012 when it delivered Dragon into the correct orbit for rendezvous with the International Space Station, making SpaceX the first commercial company ever to visit the station. Since then Falcon 9 has made numerous trips to space, delivering satellites to orbit as well as delivering and returning cargo from the space station for NASA. Falcon 9, along with the Dragon spacecraft, was designed from the outset to deliver humans into space and under an agreement with NASA, SpaceX is actively working toward this goal.

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<h1 align="left">PAYLOAD</h1>

Falcon 9 delivers payloads to space aboard the Dragon spacecraft or inside a composite fairing.

<h2 align="left">DRAGON SPACECRAFT</h2>

Dragon carries cargo in the spacecraft’s pressurized capsule and unpressurized trunk, which can also accommodate secondary payloads. In the future, Dragon will carry astronauts in the pressurized capsule as well.

<h2 align="left">COMPOSITE FAIRING</h2>

The payload fairing is for the delivery of satellites to destinations in low Earth orbit (LEO), geosynchronous transfer orbit (GTO) and beyond.

<h2 align="left">INTERSTAGE</h2>

The interstage is a composite structure that connects the first and second stages and holds the release and separation system. Falcon 9 uses an all-pneumatic stage separation system for low-shock, highly reliable separation that can be tested on the ground, unlike pyrotechnic systems used on most launch vehicles.

<h2 align="left">FIRST STAGE</h2>

Falcon 9’s first stage incorporates nine Merlin engines and aluminum-lithium alloy tanks containing liquid oxygen and rocket-grade kerosene (RP-1) propellant. After ignition, a hold-before-release system ensures that all engines are verified for full-thrust performance before the rocket is released for flight. Then, with thrust greater than five 747s at full power, the Merlin engines launch the rocket to space. Unlike airplanes, a rocket's thrust actually increases with altitude; Falcon 9 generates more than 1.7 million pounds of thrust at sea level but gets up to over 1.8 million pounds of thrust in the vacuum of space. The first stage engines are gradually throttled near the end of first-stage flight to limit launch vehicle acceleration as the rocket’s mass decreases with the burning of fuel.

<h2 align="left">ENGINES</h2>

   9

<h2 align="left">BURN TIME</h2>

 162 sec

<h2 align="left">THRUST AT SEA LEVEL</h2>

7,607 kN 1,710,000 lbf

<h2 align="left">THRUST IN VACUUM</h2>

8,227 kN 1,849,500 lbf

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<h1 align="right">SECOND STAGE</h1>

The second stage, powered by a single Merlin vacuum engine, delivers Falcon 9’s payload to the desired orbit. The second stage engine ignites a few seconds after stage separation, and can be restarted multiple times to place multiple payloads into different orbits. For maximum reliability, the second stage has redundant igniter systems. Like the first stage, the second stage is made from a high-strength aluminum-lithium alloy.

<h2 align="right">ENGINES</h2>

1

```
<h2 align="right">BURN TIME</h2>

<p><font face="sans serif" size="6"> &nbsp397 sec</font></p>

<h2 align="right">THRUST</h2>

<p><font face="sans serif" size="6">934 kN 210,000 lbf</font></p>

<h1 align="right"><font size="5">NINE MERLIN ENGINES</font></h1>

<p align="justify"><font face="sans serif" size="4">With its nine first-stage Merlin engines clustered together, Falcon 9 can sustain up to two engine shutdowns during flight and still successfully complete its mission. Falcon 9 is the only launch vehicle in its class with this key reliability feature.<font></p>

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<th colspan="5"><p align="left"><font color="#FFFFFF" size="6">TECHNICAL OVERVIEW</font></p></th>

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<font color="#FFFFF" size="4">70 m 229.6 ft</font></td>

<td><u><font color="#FFFFF" size="4">MASS</font></u><br>
<font color="#FFFFF" size="4">549,054 kg 1,207,920 lb</font></td>
<td><u><font color="#FFFFF" size="4">PAYLOAD TO LEO</font></u><br>
<font color="#FFFFF" size="4">22,800 kg 50,265 lb</font></td>
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<font color="#FFFFF" size="4">4,020 kg 8,860lb</font></td>
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<tr>
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<td><u><font color="#FFFFF" size="4">STAGES</font></u><br>
<font color="#FFFFF" size="4">2</font></td>
<td><u><font color="#FFFFF" size="4">PAYLOAD TO GTO</font></u><br>
<font color="#FFFFF" size="4">8,300 kg 18,300 lb</font></td>
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<td align="center"><font color="#FFFFFF" size="3" face="sans serif">ROCKET ROAD</font></td>

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<td align="center"><font color="#FFFFFF" size="3" face="sans serif">FALCON HEAVY</font></td>

<td align="center"><font color="#FFFFFF" size="3" face="sans serif">LAUNCH MANIFEST</font></td>

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EXPLORATION  &nbspTECHNOLOGIES CORP.</font></td>

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falcon_heavy.html

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        transition: all 0.6s;
        }
        a:hover{
         color:coral;
        }
       </style>
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<td width="6"></td>



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size="+1">CAREERS</font></center></td>

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<h1><font color="#FFFFFF">FALCON HEAVY</font></h1>

<p align="justify"><font color="#FFFFFF" face="sans serif" size="4">Falcon Heavy
is the most powerful operational rocket in the world by a factor of two. With the
ability to lift into orbit nearly 64 metric tons (141,000 lb)---a mass greater than a
737 jetliner loaded with passengers, crew, luggage and fuel--Falcon Heavy can lift
more than twice the payload of the next closest operational vehicle, the Delta IV
Heavy, at one-third the cost. Falcon Heavy draws upon the proven heritage and
reliability of Falcon 9.</font></p>
```

<p align="justify">Its first stage is composed of three Falcon 9 nine-engine cores whose 27 Merlin engines together generate more than 5 million pounds of thrust at liftoff, equal to approximately eighteen 747 aircraft. Only the Saturn V moon rocket, last flown in 1973, delivered more payload to orbit. Falcon Heavy was designed from the outset to carry humans into space and restores the possibility of flying missions with crew to the Moon or Mars.</p>
</td>

</td>

<td width="33%"><img src="../images/4.jpg" style="float : right" height="450" width="600"></td>

</table>

<p align="right">FALCON HEAVY PAD   &</p>

<hr color="303030">

<table width="100%" height="1400" border="0" style="color:#efefef">

<tr>

<td width="10%"></td>

<td width="30%">

<h1 align="left">PAYLOAD</h1>

Falcon Heavy missions will deliver large payloads to orbit inside a composite fairing, but the rocket can also carry the Dragon spacecraft.

<h2 align="left">COMPOSITE FAIRING</h2>

The composite payload fairing protects satellites during delivery to destinations in low Earth orbit (LEO), geosynchronous transfer orbit (GTO) and beyond.

<h2 align="left">SECOND STAGE</h2>

Falcon Heavy draws upon Falcon 9's proven design, which minimizes stage separation events and maximizes reliability. The second-stage Merlin engine, identical to its counterpart on Falcon 9, delivers the rocket's payload to orbit after the main engines cut off and the first-stage cores separate. The engine can be restarted multiple times to place payloads into a variety of orbits including low Earth, geosynchronous transfer orbit (GTO) and geosynchronous orbit (GSO).

<h2 align="left">ENGINES</h2>

<font face="sans serif"
size="6">   1

<h2 align="left">BURN TIME</h2>

 397 sec

<h2 align="left">THRUST IN VACCUM</h2>

934 kN 210,000 lbf

<h2 align="left">FIRST STAGE</h2>

Three cores make up the first stage of Falcon Heavy. The side cores, or boosters, are connected at the base and at the top of the center core's liquid oxygen tank. The three cores, with a total of 27 Merlin engines, generate 22,819 kilonewtons (5.13 million pounds) of thrust at liftoff. Shortly after liftoff the center core engines are throttled down. After the side cores separate, the center core engines throttle back up to full thrust.

<h2 align="left">CORES</h2>

   3

<h2 align="left">ENGINES</h2>

   27

<h2 align="left">THRUST AT SEA LEVEL</h2>

22,819 kN 5,130,000 lbf

<h2 align="left">THRUST IN VACUUM</h2>

24,681 kN 5,548,500 lbf

<h2 align="left">BOOSTERS</h2>

Each of Falcon Heavy's side cores, or boosters, is equivalent to the first stage of a Falcon 9 rocket with nine Merlin engines. At liftoff, the boosters and the center core all operate at full thrust. Shortly after liftoff, the center core engines are throttled down. After the side cores separate, the center core engines throttle back up.

<h2 align="left">THREE NINE-ENGINE CORES</h2>

<p align="justify">Inside each of Falcon Heavy's three cores is a cluster of nine Merlin engines. These same engines power Falcon 9, enabling efficiencies that make Falcon Heavy the most cost-effective heavy-lift launch vehicle in the world. With a total of 27 first-stage engines, Falcon Heavy has engine-out capability that no other launch vehicle can match—under most payload scenarios, it can sustain more than one unplanned engine shutdown at any point in flight and still successfully complete its mission.</p>

<p align="left"><a><img src="../images\6.jpg" style="float : left" height="250" width="600"></p>

<p align="left">   CORE/ENGINE LAYOUT</p>

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<td width="20%" height="50"><center><img src="../images/5.png" height="1500" width="300"></center></td>

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<td><u><font color="#FFFFF" size="4">HEIGHT</font></u><br>

<font color="#FFFFF" size="4">70 m 229.6 ft</font></td>

<td><u><font color="#FFFFF" size="4">STAGES</font></u><br>

<font color="#FFFFF" size="4">2</font></td>

<td><u><font color="#FFFFF" size="4">BOOSTERS</font></u><br>

<font color="#FFFFF" size="4">2</font></td>

<td><u><font color="#FFFFF" size="4">PAYLOAD TO LEO</font></u><br>

<font color="#FFFFF" size="4">63,800 kg 140,660 lb</font></td>

<td><u><font color="#FFFFF" size="4">PAYLOAD TO MARS</font></u><br>

<font color="#FFFFF" size="4">16,800 kg 37,040 lb</font></td>

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<tr>

<td><u><font color="#FFFFF" size="4">TOTAL WIDTH</font></u><br>

<font color="#FFFFF" size="4">12.2 m 39.9 ft</font></td>
```

```
<td><u><font color="#FFFFF" size="4">MASS</font></u><br>

<font color="#FFFFF" size="4">1,420,788 kg 3,125,735 lb</font></td>

<td><u><font color="#FFFFF" size="4">PAYLOAD TO GTO</font></u><br>

<font color="#FFFFF" size="4">26,700 kg 58,860 lb</font></td>

<td><u><font color="#FFFFF" size="4">PAYLOAD TO PLUTO</font></u><br>

<font color="#FFFFF" size="4">3,500 kg 7,720 lb</font></td>

</tr>


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<p align="right"><a><img src="../images\7.jpg" style="float : right" height="250"
width="700"></a></p>

<h1><font color="#FFFFFF">THE WORLD'S MOST POWERFUL
ROCKET</font></h1>

<p align="justify"><font color="#FFFFFF" size="4" face="sans serif">WITH MORE
THAN 5 MILLION POUNDS OF THRUST AT LIFTOFF, FALCON<br>Heavy will be the
most capable rocket flying. By comparison,the liftoff thrust of the<br>Falcon
Heavy equals approximately eighteen 747 aircraft at full power. Below is
a<br>comparison chart of the world’s heavy lift vehicles, based on historical
launch data.<br>Falcon Heavy can lift the equivalent of a fully loaded 737 jetliner-
-complete with<br>passengers, luggage and fuel--to orbit. Only the Saturn V
moon rocket, last flown in<br>1973, delivered more payload to orbit than Falcon
Heavy.</font></p>

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<tr>

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<th width="20%" height=""><center><font face="sans serif" size="4" align="right" color="#FFFFFF">UPDATES</font></center></th>

<th width="20%" height=""><center><font face="sans serif" size="4" align="right" color="#FFFFFF">ABOUT SPACEX</font></center></th>

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<td align="center"><font color="#FFFFFF" size="3" face="sans serif">COMPANY</font></td>
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ROAD</font></td>

<td></td>

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<tr>

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HEAVY</font></td>

<td align="center"><font color="#FFFFFF" size="3" face="sans serif">LAUNCH
MANIFEST</font></td>

<td align="center"><font color="#FFFFFF" size="3" face="sans
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<td align="center"><font color="#FFFFFF" size="3" face="sans
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<td width="22%" align="center"><font color="#FFFFFF">© 2018 SPACE
EXPLORATION  &nbspTECHNOLOGIES CORP.</font></td>

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dragon.html

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        transition: all 0.6s;
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href="../web\falcon_heavy.html">FALCON HEAVY</a></font></center></td>

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SpaceX\project 1.html">ABOUT SPACEX</a></font></center></td>

<td width="62"><center><font color="#FFFFFF"
size="+1">CAREERS</font></center></td>

<td width="62"><center><font color="#FFFFFF" size="+1"><a
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height="70%"><source src="..\video/Dragon Spacecraft.mp4"></video></td>

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<h1><font color="#FFFFFF">DRAGON</font></h1>

<p><a><img src="../images\8.jpg" style="float : right" height="350"
width="550"></a></p>

<p align="justify"><font color="#FFFFFF" face="sans serif" size="4">Dragon is a
free-flying spacecraft designed to<br>deliver both cargo and people to
orbiting<br>destinations. Dragon made history in 2012 when it<br>became the
first commercial spacecraft in history<br>to deliver cargo to the International
Space Station<br>and safely return cargo to Earth, a feat previously<br>achieved
only by governments. It is the only<br>spacecraft currently flying that is capable
of<br></font></p>

<p align="justify"><font color="#FFFFFF" face="sans serif" size="4">returning
significant amounts of cargo to Earth.<br>Currently Dragon carries cargo to space,
but it<br>was designed from the beginning to carry humans.<br>Under an
agreement with NASA, SpaceX is now<br>developing the refinements that will
enable Dragon<br>to fly crew. Dragon's first manned test flight is<br>expected to
take place as early as 2018.<br></font></p>
```

```
<h1 align="right"><font color="#FFFFFF" size="5">DRAGON CAPSULES                      </font></h1>

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<h1>OVERVIEW </h1>

<p><font size="4" face="sans serif">TOTAL LAUNCH PAYLOAD MASS</font></p>

<p><font size="5" face="sans serif">6,000 kg 13,228 lbs</font></p>

<p><font size="4" face="sans serif">TOTAL LAUNCH PAYLOAD VOLUME</font></p>

<p><font size="5" face="sans serif">25m<sup>3</sup> 883 ft<sup>3</sup></font></p>

<h1>PRESSURIZED SECTION</h1>

<p align="justify"><font size="4" face="sans serif">The pressurized section of the spacecraft, also referred to as the capsule, is designed to carry both cargo and humans into space. Towards the base of the capsule but outside the pressurized structure are the Draco thrusters, Dragon's guidance navigation and control (GNC) bay and Dragon’s advanced heat shield.</font></p>

<p><font size="4" face="sans serif">SPACECRAFT PAYLOAD VOLUME</font></p>
```

11 m³ 388 ft³

<h1>TRUNK</h1>

Dragon’s trunk supports the spacecraft during ascent to space, carries unpressurized cargo and houses Dragon’s solar arrays. The trunk and solar arrays remain attached to Dragon until shortly before reentry to Earth’s atmosphere, when they are jettisoned.

TRUNK PAYLOAD VOLUME

14m³ 494 ft³

</td>

<td width="50%" background="../images\9.jpg" style=" background-size:cover; background-position: bottom" ></td>

<td width="25%" align="right">

TOTAL RETURN PAYLOAD MASS

3,000 kg 6,614 lbs

TOTAL RETURN PAYLOAD VOLUME

11m³ 388 ft³

```
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<tr>

<th colspan="5"><p align="left"><font color="#FFFFFF" size="6">TECHNICAL
OVERVIEW</font></p></th>

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<td><u><font color="#FFFFF" size="4">HEIGHT WITH TRUNK</font></u><br>

<font color="#FFFFF" size="4">7.2 m 23.6 ft</font></td>

<td><u><font color="#FFFFF" size="4">DIAMETER</font></u><br>

<font color="#FFFFF" size="4">3.7 m 12 ft</font></td>

<td><u><font color="#FFFFF" size="4">SIDEWALL ANGLE</font></u><br>

<font color="#FFFFF" size="4">15°</font></td>

<td><u><font color="#FFFFF" size="4">ORBIT DURATION</font></u><br>

<font color="#FFFFF" size="4">Up to 2 Years</font></td>

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<h1 align="center"><font size="6" color="#FFFFFF">  &nbspINSIDE
THE SPACECRAFT</font></h1>

<p align="center"><font color="#FFFFFF" face="sans serif" size="4">The Dragon
spacecraft has three configurations to meet a variety of needs:cargo, crew and
DragonLab. To ensure a rapid transition from cargo to crew capability, the cargo
and crew configurations of Dragon are almost identical. This commonality
simplifies the human rating process, allowing systems critical to crew and space
station safety to be fully tested on unmanned cargo flights. With DragonLab,
essentially the same spacecraft can be used as a platform for in-space technology
demonstrations and experiments.</font></p>



<p align="center"><a><img src="../images\10.jpg" height="500"
width="800"></a></p>

<p align="center"><font size="6" color="#FFFFFF">CARGO</font></p>

<p align="center"><a><img src="../images\11.jpg" height="500"
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<p align="center"><font size="6" color="#FFFFFF">CREW</font></p>

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```

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EXPLORATION &amp;nbsp&amp;nbspTECHNOLOGIES CORP.</font></td>

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About SpaceX
project 1.html

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SpaceX\project 1.html">ABOUT SPACEX</font></center></td>

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<h1 align="center"><font face="sans serif" color="#FFFFFF"><b><u>SPACE X</u></b></font></h1>

<p align="center"><font face="sans serif" size="5" color="#FFFFFF"><b><u>INTRODUCTION</u></b></font></p>

<p align="justify"><font color="#FFFFFF" size="4">Space Exploration Technologies Corp., doing business as Space X, is an American aerospace manufacturer and space transport services company headquartered in Hawthorne, California. It was founded in 2002 by entrepreneur Elon Musk with the goal of reducing space transportation costs and enabling the colonization of Mars. Space X has since developed the Falcon launch vehicle family and the Dragon spacecraft family, which both currently deliver payloads into Earth orbit.  The company was founded in 2002 to revolutionize space technology, with the ultimate goal of enabling people to live on other planets. Space X has gained worldwide attention for a series of historic milestones. It is the only private company ever to return a spacecraft from low-Earth orbit, which it first accomplished in December 2010.</font></p>

<p align="center"><a><img src="../images\25.jpg" height="350" width="600"></a></p>

<p align="center"><font color="#FFFFFF" size="4">SpaceX hangar and Launch Pad 39A at Kennedy Space Center, December 2015</font></p>

<p align="center"><font size="5" color="#FFFFFF"><b><u>HISTORY</u></b></font></p>
```

In 2001, Elon Musk conceptualized Mars Oasis, a project to land a miniature experimental greenhouse and grow plants on Mars, "so this would be the furthest that life's ever traveled" in an attempt to regain public interest in space exploration and increase the budget of NASA. In early 2002, Musk was seeking staff for his new space company, soon to be named Space X. Musk approached rocket engineer Tom Mueller (now Space X's CTO of Propulsion) and Mueller agreed to work for Musk, and thus Space X was born. Space X was first headquartered in a warehouse in El Segundo, California. In 2016 Musk gave a speech at the International Astronautical Congress, where he stated that Space X can only hire Americans due to employees working on "advanced weapon technology".

next page

<table width="100%">

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<td width="56"><center><font color="#FFFFFF"
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<u>GOALS</u>

Musk has stated that one of his goals is to improve the cost and reliability of access to space, ultimately by a factor of ten. A major goal of Space X has been to develop a rapidly reusable launch system. Musk stated in a 2011 interview that he hopes to send humans to Mars' surface within 10–20 years. In 2010, Musk's calculations convinced him that the colonization of Mars was possible. In March 2014, COO Gwynne Shotwell said that once the Falcon Heavy and Dragon 2 crew version are flying, the focus for the company engineering team will be on developing the technology to support the transport infrastructure necessary for Mars missions.

Space X plans to send two private citizens around the Moon in its Dragon 2 spacecraft in 2018. The company has selected two participants for the mission, which is being funded by Nasa and cash from the citizens. The trip will mark the first time humans have been sent to deep space in 45 years and will launch from the same pad the Apollo programme used to send humans to the Moon in 1969. If all goes to plan, those on board will break a record for travelling the fastest and farthest into the Solar System. As part of Musk’s plan to create a colony on the planet, he hopes the first spacecraft carrying humans will set off in the mid-2020s. Before then, he hopes Space X will send an unmanned mission to Mars in 2020.

<p align="center"><u>SPACE X TO LAUNCH MOST POWERFUL COMPUTER EVER SENT TO SPACE STATION</u></p>

<p align="justify">When the Falcon 9 rocket takes off successfully, one of the items on board will be a supercomputer built by Hewlett Packard Enterprise (HPE, Tech30), dubbed the "Space borne Computer." If it works, it could be the most powerful commercial, off-the-shelf computer ever to operate in space. According to Mark Fernandez, the HPE engineer who is heading up this new experiment, the space-bound supercomputer will have the ability to make one trillion calculations in a single second -- about 30 to 100 times more powerful than your average desktop computer. Julie Robinson, the chief scientist for NASA's space station program, said if this supercomputer can function in the harsh conditions of space -- it'll be very exciting news for companies down here on earth.</p>

<p align="center"><a><img src="../images\26.jpg" height="400" width="300"></p>

<p align="center">Launch of Falcon 9 carrying ORBCOMM OG2-M1.</p>

<p align="center">previous page   next page</p>

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<u>ACHIEVEMENTS</u>

<u>Major achievements to date:</u>

• Successfully launched the Falcon 1 rocket into orbit (2008).

• Launched, orbited and recovered the Dragon spacecraft (2010).

• Delivered supplies to the ISS on the unmanned Dragon cargo ship (2012).

• Launched its first commercial satellite, SES-8, into orbit (2013).

• Launched DSCOVR - a deep-space observatory that aims to alert people on Earth of potentially dangerous solar activity and geomagnetic storms (2015).

• Successfully launched and landed the Falcon 9 rocket - a major milestone in the drive to cut costs and waste by making rockets as reusable as planes (2015).

• The first re-launch and landing of a used orbital rocket (Falcon 9 Flight 32 — March 30, 2017).

<p align="justify">• The first controlled fly-back and recovery of a payload fairing (Falcon 9 Flight 32 — March 30, 2017).</p>

<p align="justify">• The first re-flight of a commercial cargo spacecraft. (Falcon 9 Flight 35 — June 3, 2017).</p>

</p>

<p align="center"><a><img src="../images\27.jpg" height="350" width="600"></p>

<p align="center">Falcon 9 first stage on an ASDS barge after the first successful landing at sea, CRS-8 Mission.</p>

<p align="center"><a><img src="../images\28.jpg" height="400" width="300"></p>

<p align="center">Falcon Heavy on Launch Pad</p>

<p align="center">previous page   next page</p>

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<u>SPACECRAFT AND FLIGHT HARDWARE</u>

Space X currently manufactures two broad classes of rocket engine in-house: the kerosene fueled Merlin engines and the hypergolic fueled Draco/Super Draco vernier thrusters. The Merlin powers their two main space launch vehicles: the large Falcon 9, and the super-heavy class Falcon Heavy. Space X also manufactures the Dragon, a pressurized orbital spacecraft that is launched on top of a Falcon 9 booster to carry cargo to low Earth orbit, and the follow-on Dragon 2 spacecraft, currently in the process of being human-rated through a variety of design reviews and flight tests.

<u>ROCKET ENGINES</u>

Since the founding of Space X in 2002, the company has developed three families of rocket engines — Merlin and Kestrel for launch vehicle propulsion, and the Draco control thrusters. Space X is currently developing two further rocket engines: Super Draco and Raptor.

Merlin is a family of rocket engines developed by Space X for use on its Falcon rocket family of launch vehicles.

Kestrel is a LOX/RP-1 pressure-fed rocket engine, and was used as the Falcon 1 rocket's second stage main engine.

Draco are hypergolic liquid-propellant rocket engines that utilize monomethyl hydrazine fuel and nitrogen tetroxide oxidizer. Each Draco thruster generates 400 newtons (90 lbf) of thrust. They are used as reaction control system (RCS) thrusters on the Dragon spacecraft.

Raptor is a new family of methane-fueled full flow staged combustion cycle engines to be used in its future Interplanetary Transport System. Development versions have been test fired.

<u>FALCON LAUNCH VEHICLES</u>

Since 2010, Space X has flown all its missions on the Falcon 9. They are also actively developing the Falcon Heavy, and previously developed and flew the Falcon 1 pathfinder vehicle.

Falcon 1 was a small rocket capable of placing several hundred kilograms into low earth orbit. It functioned as an early test-bed for developing concepts and components for the larger Falcon 9. Falcon 1 attempted five flights between 2006 and 2009. On September 28, 2008, on its fourth attempt, the Falcon 1 successfully reached orbit, becoming the first privately funded, liquid-fueled rocket to do so.

Falcon 9 is an EELV-class medium-lift vehicle capable of delivering up to 22,800 kilograms (50,265 lb) to orbit, and is intended to compete with the Delta IV and the Atlas V rockets, as well as other launch providers around the world.

```
<p align="justify"><font size="4" color="#FFFFFF">In 2011, Space X began development of the Falcon Heavy, a heavy-lift rocket configured using a cluster of three Falcon 9 first stage cores with a total 27 Merlin 1D engines and propellant crossfeed. When Space X finishes development and the rocket is launched, the Falcon Heavy will be the world's most powerful rocket in operation. Space X is aiming for the first demonstration flight of the Falcon Heavy in November 2017.</font></p>


<p align="center"><a><img src="../images\29.jpg" height="400" width="600"></a></p>

<p align="center"><font color="#FFFFFF" size="4">The Falcon 1 prototype at SpaceX's assembly facilities.</font></p>

<p align="center"><p align="center"><a href="project3.html"><font size="5">previous page</font></a>                              <a href="project5.html"><font size="5">next page</font></a></p>



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<u>DRAGON CAPSULES</u>

In 2005, Space X announced plans to pursue a human-rated commercial space program through the end of the decade. The Dragon is a conventional blunt-cone ballistic capsule which is capable of carrying cargo or up to seven astronauts into orbit and beyond.

In addition to Space X's privately funded plans for an eventual Mars mission, NASA Ames Research Center had developed a concept called Red Dragon: a low-cost Mars mission that would use Falcon Heavy as the launch vehicle and trans-Martian injection vehicle, and the Dragon capsule to enter the Martian atmosphere.

<u>RESEARCH AND DEVELOPMENT</u>

Space X is actively pursuing several different research and development programs. Most notable are the programs intended to develop reusable launch vehicles, an interplanetary transport system, and a global telecommunications network.

Space X has on occasion developed new engineering development technologies to enable it to pursue its various goals. For example, at the 2015 GPU Technology Conference, Space X revealed their own computational fluid dynamics (CFD) software to improve the simulation capability of evaluating rocket engine combustion design.

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<p align="center"><a><img src="../images\30.jpg" height="350"
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<p align="center"><font color="#FFFFFF" size="4">First test firing of a scale
Raptor development engine in September 2016 in McGregor, Texas.</font></p>

<p align="center"><p align="center"><a href="project4.html"><font
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<u>OTHER PROJECTS</u>

In January 2015, Space X CEO Elon Musk announced the development of a new satellite constellation to provide global broadband internet service. In June 2015 the company asked the federal government for permission to begin testing for a project that aims to build a constellation of 4,000 satellites capable of beaming the Internet to the entire globe, including remote regions which currently do not have internet access. Owned and operated by Space X, the goal of the business is to increase profitability and cashflow, to allow Space X to build its Mars colony.

<u>INFRASTUCTURE</u>

Space X is headquartered in California, which also serves as their primary manufacturing plant. They own a test site in Texas, and operate three current launch sites, with another under development. Space X also run regional offices in Texas, Virginia, and Washington, D.C. and a satellite development facility in Seattle.

<u>HEADQUARTERS AND MANUFACTURING PLANT</u>

Space X Headquarters is located in the Los Angeles suburb of Hawthorne, California. The large three-story facility, originally built by Northrop Corporation to build Boeing 747 fuselages, houses Space X's office space, mission control, and vehicle factory. The area has one of the largest concentrations of aerospace headquarters, facilities, and/or

subsidiaries in the U.S., including Boeing/McDonnell Douglas main satellite building campuses, Raytheon, NASA's Jet Propulsion Laboratory, Lockheed Martin, BAE Systems, Northrop Grumman, and AECOM, etc., with a large pool of aerospace engineers and recent college engineering graduate.

<a><img src="../images\31.jpg" height="350" width="600">

The company's headquarters, located in Hawthorne, California.

previous page   next page

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<p align="center"><font size="5" color="#FFFFFF"><b><u>DEVELOPMENT AND
TEST FACILITY</u></b></font></p>

<p align="justify"><font size="4" color="#FFFFFF">Space X operates their Rocket
Development and Test Facility in McGregor, Texas. All Space X rocket engines are
tested on rocket test stands, and low-altitude VTVL flight testing of the Falcon 9
Grasshopper v1.0 and F9R Dev1 test vehicles were carried out at
McGregor.</font></p>


<p align="center"><a><img src="../images\32.jpg" height="350"
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<p align="center"><font color="#FFFFFF" size="4">Falcon 9 v1.1 rocket cores
under construction at the SpaceX Hawthorne facility, November
2014.</font></p>

<p align="center"><font size="5" color="#FFFFFF"><b><u>LAUNCH
FACILITY</u></b></font></p>

<p align="justify"><font size="4" color="#FFFFFF">Space X currently operates
three orbital launch sites, at Cape Canaveral, Vandenberg Air Force Base, and
Kennedy Space Center, and have announced plans for a fourth in Brownsville,
Texas. Space X has indicated that they see a niche for each of the four orbital
facilities and that they have sufficient launch business to fill each pad. Before it
was retired, all Falcon 1 launches took place at the Ronald Reagan Ballistic Missile
Defense Test Site on Omelek Island.</font></p>
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<p align="center"><a><img src="../images\33.jpg" height="350"
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<p align="center"><font color="#FFFFFF" size="4">SpaceX west coast launch
facility at Vandenberg Air Force Base, during the launch of CASSIOPE, September
2013.</font></p>

<p align="center"><a><img src="../images\34.jpg" height="350"
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<p align="center"><font color="#FFFFFF" size="4">Artist's impression of the
Interplanetary Spaceship on the Jovian moon Europa.</font></p>

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<u>FUNDING</u>

SpaceX is privately funded.It developed its first launch vehicle-Falcon 1-and three rocket engines-Merlin, Kestrel, and Draco-completely with private capital. SpaceX contracted with the US government for a portion of the development funding for the Falcon 9 launch vehicle, which uses a modified version of the Merlin rocket engine.SpaceX is developing the Falcon Heavy launch vehicle,the Raptor methane-fueled rocket engine,and a set of reusable launch vehicle technologies with private capital.

In August 2012, SpaceX signed a large development contract with NASA to design and develop a crew-carrying space capsule for the "next generation of U.S. human spaceflight capabilities", in order to re-enable the launch of astronauts from U.S. soil by 2017. Two other companies, Boeing and Sierra Nevada Corporation, received similar development contracts. Advances made by all three companies under Space Act Agreements through NASA's Commercial Crew Integrated Capability (CCiCap) initiative are intended to ultimately lead to the availability of commercial human spaceflight services for both government and commercial customers. As part of this agreement, SpaceX was awarded a contract worth up to $440 million for contract deliverables between 2012 and May 2014.

At the end of 2012 SpaceX had over 40 launches on its manifest, representing about $4 billion in contract revenue. Many of those contracts were already making progress payments to SpaceX, with both commercial and government (NASA/DOD) customers.As of

December 2013, SpaceX has a total of 50 future launches under contract, two-thirds of them are for commercial customers.In late 2013, space industry media began to comment on the phenomenon that SpaceX prices are undercutting the major competitors in the commercial commsat launch market—the Ariane 5 and Proton-M[—at which time SpaceX had at least 10 further geostationary orbit flights on its books.

In January 2015 SpaceX raised $1 billion in funding from Google and Fidelity, in exchange for 8.333% of the company, establishing the company valuation at approximately $12 billion. Google and Fidelity joined the then current investorship group of Draper Fisher Jurvetson, Founders Fund, Valor Equity Partners and Capricorn.

<u>NASA CONTRACTS</u>

<u>COTS</u>

In 2006, NASA announced that SpaceX had won a NASA Commercial Orbital Transportation Services (COTS) contract to demonstrate cargo delivery to the ISS, with a possible option for crew transport.This contract, designed by NASA to provide "seed money" for developing new boosters, paid SpaceX $278 million to develop the Falcon 9.In December 2010, the launch of the COTS Demo Flight 1 mission, SpaceX became the first privately funded company to successfully launch, orbit and recover a spacecraft.Dragon was successfully deployed into orbit, circled the Earth twice, and then made a controlled re-entry burn for a splashdown in the Pacific Ocean.With Dragon's safe recovery, SpaceX became the first private company to launch, orbit, and recover a spacecraft; prior to this mission, only government agencies had been able to recover orbital spacecraft.COTS Demo Flight 2 launched in May 2012, in which Dragon successfully berthed with the ISS, marking the first time that a private spacecraft had accomplished this feat.

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<p align="center"><a><img src="../images\35.jpg" height="350"
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<p align="center"><font color="#FFFFFF" size="4">The COTS 2 Dragon is berthed
to the ISS by Canadarm2.</font></p>

<p align="center"><p align="center"><a href="project7.html"><font
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bsp     <a href="project9.html"><font size="5">next
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project9.html

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        transition: all 0.6s;
        }
        a:hover{
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<u>DEFENSE CONTRACTS</u>

In 2005, SpaceX announced that it had been awarded an Indefinite Delivery/Indefinite Quantity (IDIQ) contract for Responsive Small Spacelift (RSS) launch services by the United States Air Force, which could allow the Air Force to purchase up to $100 million worth of launches from the company. In April 2008, NASA announced that it had awarded an IDIQ Launch Services contract to SpaceX for up to $1 billion, depending on the number of missions awarded. The contract covers launch services ordered by June 2010, for launches through December 2012.Musk stated in the same 2008 announcement that SpaceX has sold 14 contracts for flights on the various Falcon vehicles. In December 2012, SpaceX announced its first two launch contracts with the United States Department of Defense. The United States Air Force Space and Missile Systems Center awarded SpaceX two EELV-class missions: Deep Space Climate Observatory (DSCOVR) and Space Test Program 2 (STP-2). DSCOVR was launched on a Falcon 9 launch vehicle in 2015, while STP-2 will be launched on a Falcon Heavy in 2017.

In May 2015, the United States Air Force announced that the Falcon 9 v1.1 was certified for launching "national security space missions," which allows SpaceX to contract launch services to the Air Force for any payloads classified under national security. In April 2016, the U.S. Air Force awarded the first such national security launch, an $82.7 million contract to SpaceX to launch a GPS satellite in May 2018; this estimated cost was approximately 40% less than the estimated cost for similar previous missions. In April 2016, the Pentagon announced that SpaceX has been awarded an $82.7

million contract from the U.S. Air Force to launch a next-generation GPS satellite aboard its Falcon 9 rocket in May 2018.

<u>COMMERCIAL CONTRACTS</u>

SpaceX announced in March 2010, that it had been contracted to launch SES-8, a telecommunications satellite for SES S.A.; it was successfully launched in December 2013.SES-8 was SpaceX's first launch of a geostationary comsat, signalling its entrance into the lucrative commercial launch market. In June 2010, SpaceX was awarded the largest-ever commercial launch contract, worth $492 million, to launch Iridium satellites using Falcon 9 rockets. As of December 2013, SpaceX had a total of 50 future launches under contract; two-thirds of them for commercial customers.

<u>SETBACKS</u>

In March 2013, a Dragon spacecraft in orbit developed issues with its thrusters. Due to blocked fuel valves, the craft was unable to properly control itself. SpaceX engineers were able to remotely clear the blockages. Because of this issue, the craft arrived at and docked with the International Space Station one day later than expected.

In June 2015, CRS-7 launched a Dragon capsule atop a Falcon 9 to resupply the International Space Station. All telemetry readings were nominal until 2 minutes and 19 seconds into the flight, when a loss of helium pressure was detected and a cloud of vapor appeared outside the second stage. A few seconds after this, the second stage exploded. The first stage continued to fly for a few seconds before disintegrating due to aerodynamic forces. The capsule was thrown off and survived the explosion, transmitting data until it was destroyed on impact.

In September 2016, a Falcon 9 exploded during a propellant fill operation for a standard pre-launch static fire test. The payload, the Spacecom Amos-6 communications satellite valued at $200 million, was destroyed. Musk described the event as the "most difficult and complex failure" ever in SpaceX's history; SpaceX reviewed nearly 3,000 channels of telemetry and video data covering a period of 35–55 milliseconds for the postmortem. Musk reported the explosion was caused by the liquid oxygen that is used as propellant turning so cold that it solidified and it ignited with carbon composite helium vessels.

previous page   next page

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<td width="22%" align="center">© 2018 SPACE EXPLORATION   TECHNOLOGIES CORP.</td>

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project10.html

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<u>LAUNCH MARKET COMPETITION AND PRICING PRESSURE</u>

SpaceX's low launch prices, especially for communication satellites flying to geostationary (GTO) orbit, have resulted in market pressure on its competitors to lower their own prices. Prior to 2013, the openly competed comsat launch market had been dominated by Arianespace (flying Ariane 5) and International Launch Services (flying Proton).With a published price of US$56.5 million per launch to low Earth orbit, "Falcon 9 rockets [were] already the cheapest in the industry. Reusable Falcon 9s could drop the price by an order of magnitude, sparking more space-based enterprise, which in turn would drop the cost of access to space still further through economies of scale." SpaceX has publicly indicated that if they are successful with developing the reusable technology, launch prices in the US$5 to 7 million range for the reusable Falcon 9 are possible.

In 2014, SpaceX had won nine contracts out of 20 that were openly competed worldwide in 2014 at commercial launch service providers. Space media reported that SpaceX had "already begun to take market share" from Arianespace. Arianespace has requested that European governments provide additional subsidies to face the competition from SpaceX. European satellite operators are pushing the ESA to reduce Ariane 5 and the future Ariane 6 rocket launch prices as a result of competition from SpaceX. According to one Arianespace managing director in 2015, it was clear that "a very significant challenge [was] coming from SpaceX ... Therefore things have to change ... and the whole European industry is being restructured, consolidated, rationalised and streamlined."

Also in 2014, SpaceX capabilities and pricing began to affect the market for launch of US military payloads. For nearly a decade the large US launch provider United Launch Alliance (ULA) had faced no competition for military launches. Anticipating a slump in domestic military and spy launches, ULA stated that it would go out of business unless it won commercial satellite launch orders. To that end, ULA announced a major restructuring of processes and workforce in order to decrease launch costs by half.

<a><img src="../images\36.jpg" height="350" width="600">

The Falcon 9 carrying the Intelsat35e communications satellite into orbit.

previous page

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- *http://www.spacex.com/*
- *https://www.w3schools.com/html/*

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