



Exit Routes, Emergency Action Plans, Fire Prevention Plans, and Fire Protection

Dmytro Zubov, PhD

dmytro.zubov@ucentralasia.org



Naryn, Kyrgyzstan, 4 pm, October 17, 2020



An Electric Bus Caught Fire After Battery Explosion in Paris

<https://www.youtube.com/watch?v=5r-yN8SugWM>



How to Survive: An Exploding Electric Car

https://www.youtube.com/watch?v=h3ZHouT_jEA



Examples of Lithium Battery Fires

<https://www.youtube.com/watch?v=8nz5ijXcckI>



Please check your smartphone ...

Lessons learnt last time

- Accident prevention
- Safety Management Software
- Basic concepts and techniques of electrical safety-related work practices
- BIOS & UEFI (optional)



What we gonna discuss today?

- Emergency Action Plan
- Fire Protection Plan
- Conditions requiring evacuation
- Conditions requiring shelter-in-place
- Emergency escape routes
- Extinguishing fires
- Maintenance of extinguisher
- Fire alarm system based on Arduino Mega and Ethernet boards, LED, DHT11 temperature and humidity sensor



Introduction

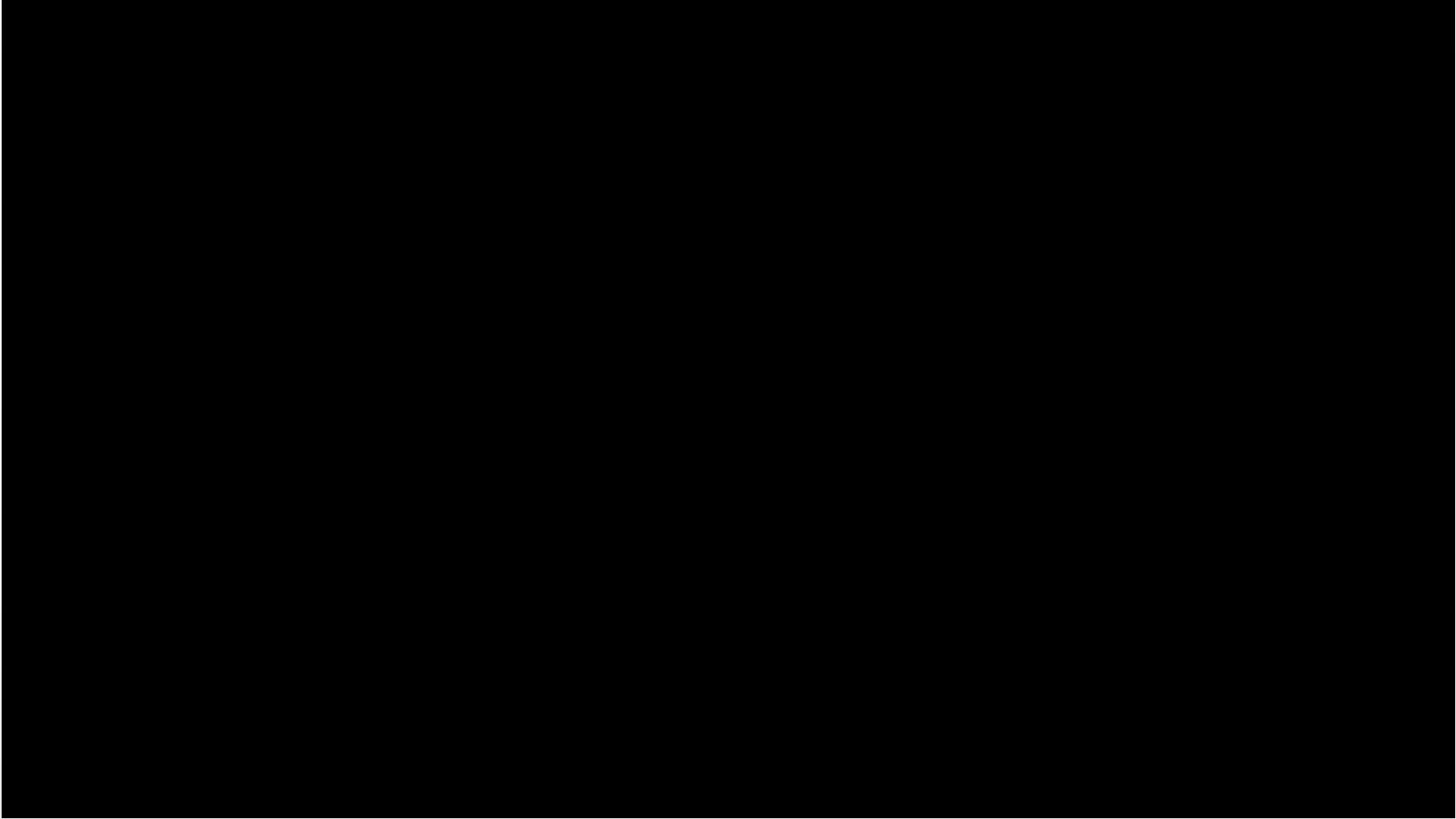
<https://www.osha.gov>



- Fires and explosions, as well as other workplace incidents, may require emergency actions and evacuations to protect employees

Introduction

<https://www.youtube.com/watch?v=WxuyHD9X6nE>



- Fire Protection Systems for Data Centers and Colocation Facilities

Emergency Action Plan



- Examples of emergency situations:
 - Workplace hazards: chemicals spills, car or boat accidents, faulty and dangerous equipment, power failures
 - Natural disasters: cyclones, floods, severe storms, fire
 - Environment hazards: snake and spider bite, falling branches, drowning
 - Catering hazards: food poisoning, fire injuries
 - People: intoxication, violence, bomb threats, medical conditions, suicide, getting lost

Emergency Action Plan (EAP)



- Benefits of an EAP:

- Written document that facilitates and organizes employer and employee actions during workplace emergencies
- Fewer and less severe injuries
- Less structural damage
- Reduce confusion



Emergency Action Plan (EAP)

- Purpose of an EAP:

- Describes actions to be taken to ensure employee safety during an emergency
- Uses floor plans/maps to show emergency escape routes
- Tells employees what actions to take
- Covers reasonably expected emergencies



Emergency Action Plan (EAP)

- Required elements of EAP:
 - Means of reporting
 - Evacuation procedures and emergency escape routes
 - Procedures for critical operations
 - Accounting of employees
 - Rescue and medical duties
 - Contact persons



Emergency Action Plan (EAP)

- Training employees on the EAP
 - Review plan with each employee
 - Initial development of plan
 - Initial assignment of employee to job
 - Changes to plan or employee actions/responsibilities
 - Annual retraining with drills to practice evacuation and gathering in assembly area
 - Educate/train
 - Types of emergencies
 - Course of actions
 - Functions and elements of EAP
 - Special hazards
 - Fire hazards and fire prevention plan



Emergency Action Plan (EAP)

- General training
 - Roles and responsibilities
 - Threats, hazards, protective actions
 - Notification, warning, communications
 - Locating family members
 - Location/use of emergency equipment
 - Procedures
 - Emergency response
 - Evacuation and shelter-in-place
 - Assembly and accounting of employees
 - Emergency shut-down



Emergency Action Plan (EAP)

- Examples of procedures:
 - Methods of reporting an emergency
 - Instructions for exit
 - Instructions for limited mobility



"СОГЛАСОВАНО"
Начальник ОГПС Нарымской области
Боскулчина Ч.Э.
20.02.2016г.
М.П.

FIRE EVACUATION PLAN
ACADEMIC BLOCK LEVEL 3

ПЛАН ПОЖАРНОЙ ЭВАКУАЦИИ
АКАДЕМИЧЕСКИЙ БЛОК ЭТАЖ 3

"УТВЕРЖДАЮ"
Менеджер по эксплуатационным службам
УПА Кызылары
Сыдыбаев К.Н.
20.02.2016г.
М.П.

A detailed floor plan of the Academic Block Level 3. The plan shows various rooms, hallways, and exits. Red numbers 1 through 7 are placed on the map to indicate specific points of interest or assembly areas. A legend on the right side defines these numbers: 1 (red circle with a white exclamation mark) for 'Сигнал тревоги, оповещение о пожаре, звонок в дежурную часть' (Warning signal, fire alarm, call to the duty office); 2 (red circle with a white 'E' inside) for 'Дежурный по пожарной безопасности' (Fire safety officer); 3 (red circle with a white 'K' inside) for 'Сигнализация' (Signaling); 4 (red circle with a white 'F' inside) for 'Оператор пожарной лестницы' (Fire escape operator); 5 (red circle with a white 'R' inside) for 'Руководитель эвакуации' (Evacuation leader); 6 (red circle with a white '+' inside) for 'Аварийный выход' (Emergency exit); and 7 (red circle with a white star inside) for 'YOU ARE HERE'.

IN CASE OF FIRE CALL
ПРИ ПОЖАРЕ ЗВОНИТЬ 101

RESPONSIBLE PERSON FOR FIRE SAFETY
SADYROV M.A.

ОТВЕТСТВЕННЫЙ ЗА ПРОТИВОПОЖАРНУЮ БЕЗОПАСНОСТЬ
САДЫРОВ М.А.

Where should we go if the fire happens?

Fire Prevention Plan (FPP)

- FPP requirements:

- Must be
 - In writing
 - Kept in the workplace
 - Available to employees for review
- Employer must
 - Inform employees of fire hazards when initially assigned to a job
 - Review with each employee applicable FPP parts

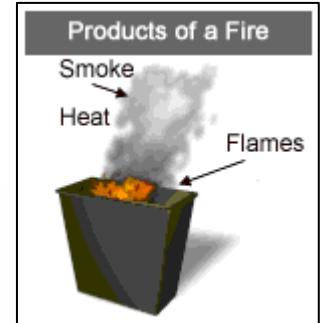


Fire Prevention Plan (FPP)

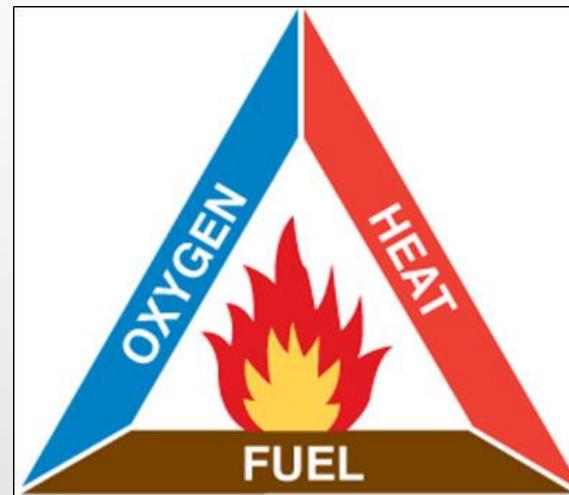


- Included in FPP
 - Lists of all major fire hazards, proper handling and storage of hazardous materials, ignition sources/controls, and fire protection equipment
 - Procedures to control flammable/combustible wastes
 - Procedures for maintenance of safeguards on heat-producing equipment
 - Name/job titles of employees with responsibilities for maintenance of equipment and control of hazards

Fire Prevention Plan (FPP)



- Preventing fires hazards: Understanding fires
 - Rapid chemical reaction between oxygen and a combustible material
 - Results in the release of heat, light, flames, and smoke
 - Requires four elements:
 - Oxygen
 - Ignition source (heat)
 - Fuel
 - Chemical reaction



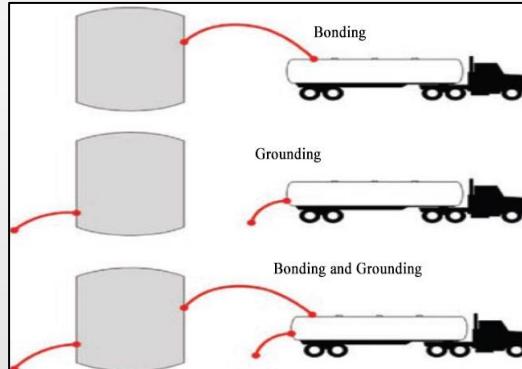
Fire Prevention Plan (FPP)

- Ignition sources
 - Open flames
 - Smoking
 - Static electricity
 - Hotwork
 - Hot surfaces
 - Electrical and mechanical sparks
 - Lightning



Fire Prevention Plan (FPP)

- Tasks that require fire protection and examples of hazards
 - Hotwork – 30-minute fire watch
 - Dispensing flammables and combustibles: gasoline, diesel, or natural gas
 - Flammable wastes: solvent waste, oily rags, and flammable liquids



Fire Prevention Plan (FPP)

- Handling of flammable hazards

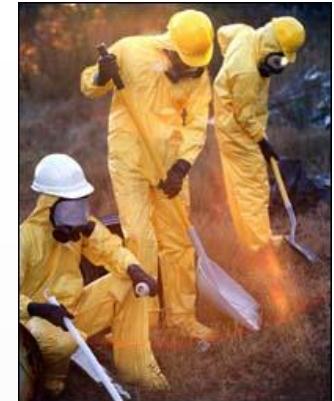
- Only use approved metal safety containers or original manufacturer's containers for storage
- Practice good housekeeping
- Keep containers closed when not in use
- Store away from exits or passageways
- Keep away from ignition sources



Fire Prevention Plan (FPP)

- Fire protection equipment

- PPE
- Fire Suppression
 - Portable fire extinguishers
 - Fixed systems



Conditions Requiring Evacuation

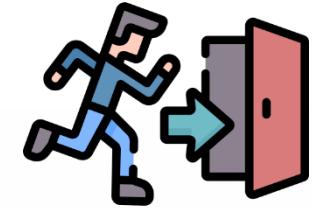
- Workplace evacuation may be required for:

- **Man-made emergencies**

- Fires
- Explosions
- Toxic material releases
- Radiological/biological incidents
- Civil disturbances
- Workplace violence

- **Natural emergencies**

- Floods
- Earthquakes
- Hurricanes
- Tornadoes
- Wildfires
- Winter weather



Conditions Requiring Evacuation

- Factors affecting response to emergencies:
 - Type/extent of emergency
 - Location of emergency
 - Type of building in which workplace is located
 - Shutting down critical operations



Conditions Requiring Evacuation

- Fire emergencies: **Fight or Flee?**
 - Options for evacuation
 - Total evacuation
 - Designated employees authorized to fight fire; all others evacuate
 - All employees authorized to fight fire



Conditions Requiring Evacuation



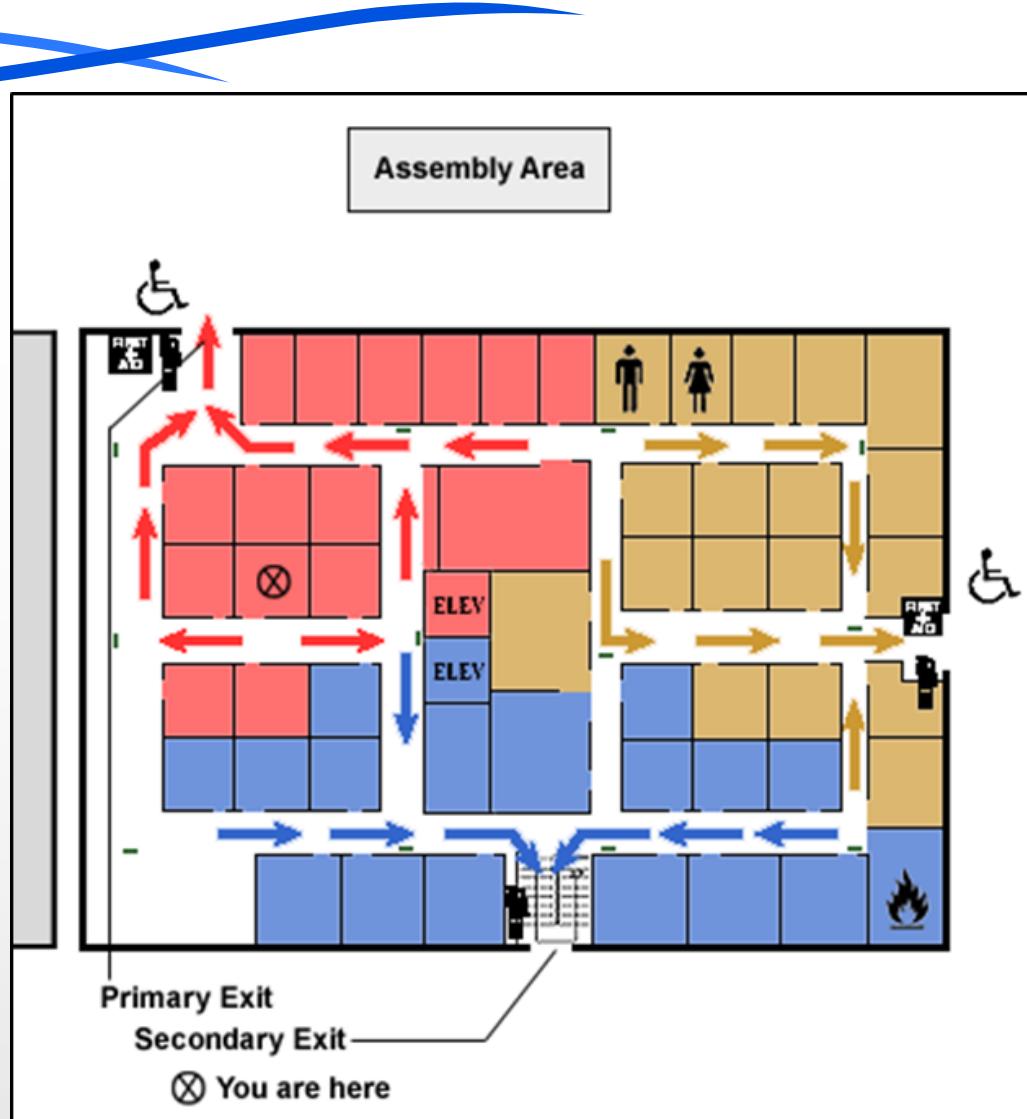
- Fire emergencies: **Fight or Flee?**

- Performing a risk assessment
 - Is the fire too big?
 - Is the air safe to breathe?
 - Is the environment too hot or smoky?
 - Is there a safe evacuation path?



Conditions Requiring Evacuation

- Evacuation maps show:
 - Exits: to, thru, and away
 - At least two ways out
 - Primary exit
 - Secondary exit
 - Assembly area
 - Location on the map
 - Additional information –
Location of fire extinguishers



Conditions Requiring Evacuation

- Evacuation actions:

- Alerting employees to **evacuate**

- Alarm
 - Enunciator panel/speaker

- Accounting for who has **exited**

- How is that accomplished

- Keeping employees **informed**

- All clear, re-enter, or remain at assembly point
 - Clear to leave workplace



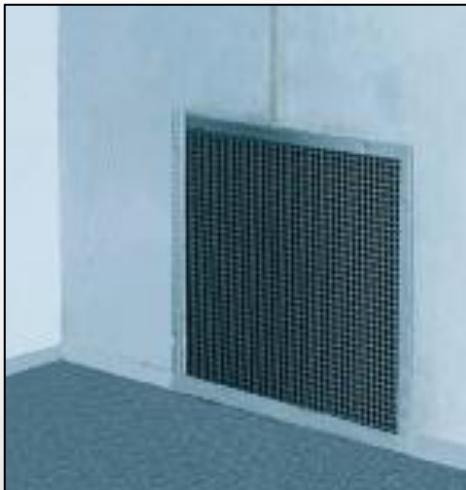
Conditions Requiring Shelter-in-Place

- Incidents that may require shelter-in-place:
 - Release of chemical, biological, or radiological contaminants
 - Severe weather – tornadoes
 - Other situations occurring outside the workplace



Conditions Requiring Shelter-in-Place

- Shelter-in-place:
 - Means taking refuge in interior room(s) with no/few windows
 - Local authorities often issue shelter-in-place advice via TV or radio
 - Procedures specific to worksite



Conditions Requiring Shelter-in-Place



- An example of a shelter-in-place warning

URGENT - IMMEDIATE BROADCAST REQUESTED

SHELTER IN PLACE WARNING

BY ORDER OF LOS ANGELES POLICE DEPARTMENT, CALTRANS AND CALIFORNIA HIGHWAY PATROL

RELAYED BY LOS ANGELES POLICE DEPARTMENT

12:00 PM PST SAT DEC 20 2016

THE FOLLOWING MESSAGE IS TRANSMITTED AT THE REQUEST OF THE
LOS ANGELES POLICE DEPARTMENT.

THE LOS ANGELES POLICE DEPARTMENT ARE ASKING ALL RESIDENTS OF LOS ANGELES COUNTY TO STAY INDOORS.
AT 12:00 PACIFIC STANDARD TIME A CAR ACCIDENT HAS OCCURRED ON INTERSTATE 5 OUTSIDE LOS ANGELES
COUNTY.

THIS MOTOR VEHICLE ACCIDENT INCLUDED A SEMI TRUCK CARRYING 5 TONS OF SULFURIC ACID AND TOXIC GAS.
FIRE FROM ACID HAD RELEASED TOXIC GAS THAT IS IN THE AIR. THE DIRECTION THAT THE WIND PUSHED THE GAS
INTO DOWNTOWN LOS ANGELES. SHELTER IN PLACE IS IN EFFECT WITHIN 5 MILES OF THIS AREA.

PLEASE DO NOT GO OUTDOORS AND REMAIN AWAY FROM WINDOWS OR ANY OPEN DOORS.

PLEASE STAY TUNED TO MEDIA OUTLETS FOR FURTHER INFORMATION.

Conditions Requiring Shelter-in-Place

- Planning shelter-in-place actions:
 - Alerting employees – **shelter-in-place**
 - Accounting for who is in **refuge**
 - Keeping employees informed



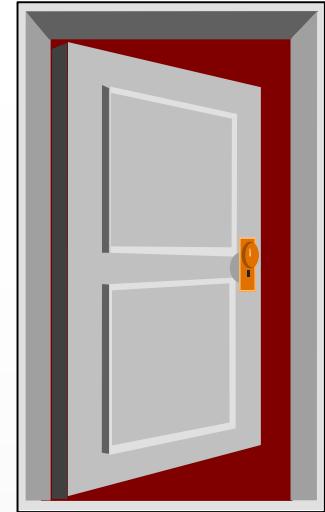
Emergency Escape Routes

- Exit routes:
 - Continuous and unobstructed path of exit travel from any place in workplace to safety
 - Exit access, exit, exit discharge
 - Should be:
 - Clearly marked
 - Well-lit
 - Appropriate width
 - Unobstructed/clear



Emergency Escape Routes

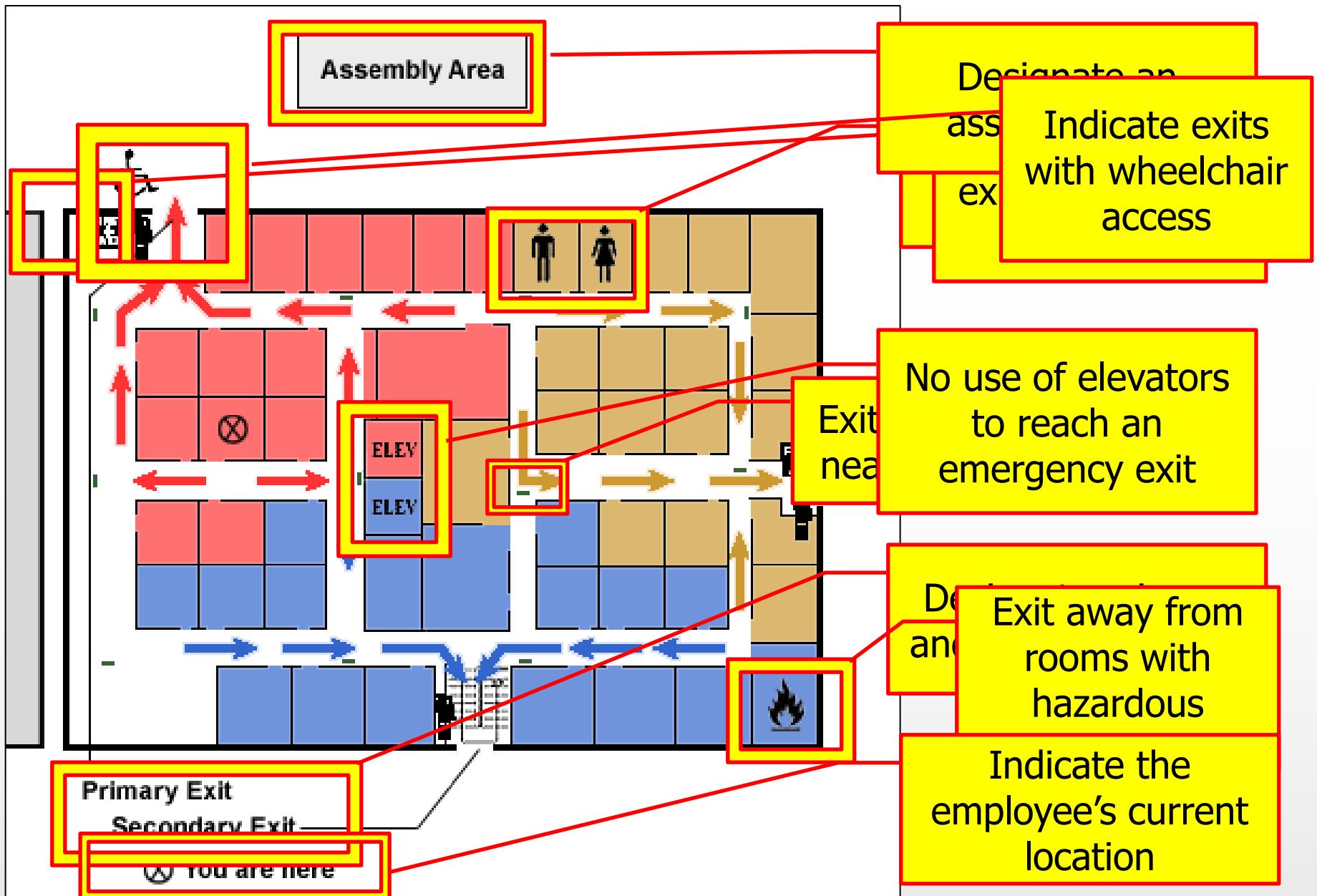
- Basic exit route requirements:
 - Permanent
 - Separated by fire-resistant materials
 - Limited openings
 - Adequate number of exit routes
 - Discharge leading directly outside or to a place with access to outside
 - Exit door unlocked from inside and side-hinged
 - Adequate capacity
 - Minimum height and width



Emergency Escape Routes

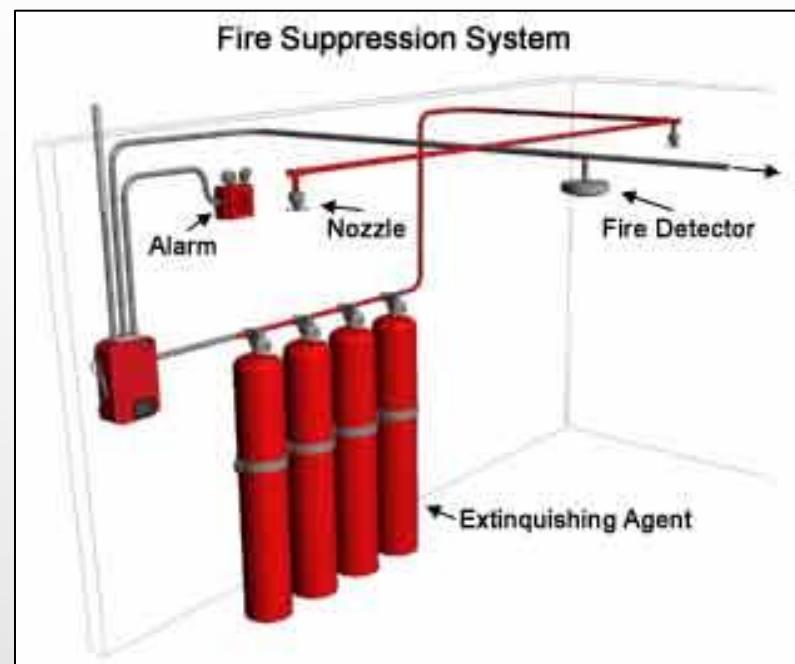
- Clearly communicate 3 elements of escape route
 - Exit access pathway
 - Nearest exits from all points of building
 - Pathway away from building structure





Extinguishing Fires

- Methods of fire protection:
 - Fixed extinguishing systems
 - Fire brigades
 - Fire extinguishers



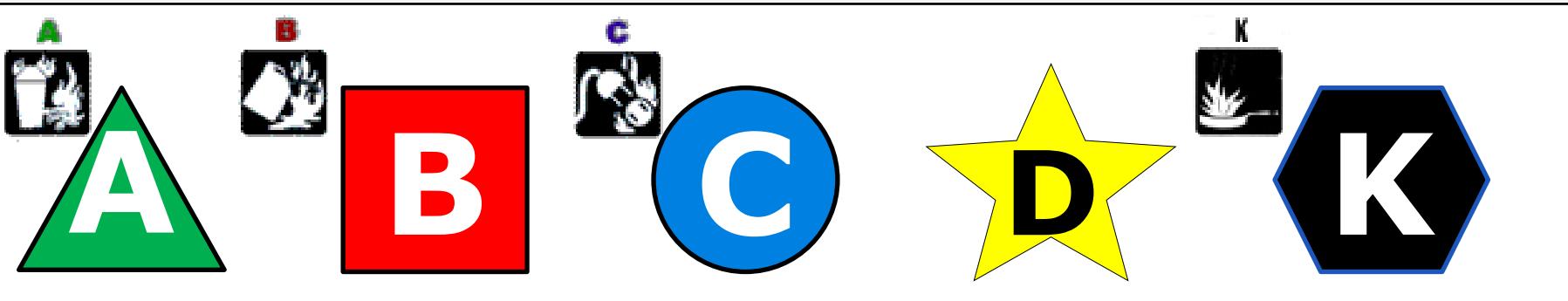
Extinguishing Fires

- Portable fire extinguisher training and education
 - Required for employees authorized to use fire extinguishers
 - General principles of fire extinguisher use
 - Hazards of incipient stage of fire fighting
 - Operation of equipment (instruction and hands-on practice)
 - Required upon initial employment/assignment and at least annually thereafter



Extinguishing Fires

- Classes of fires:
 - Class A – ordinary combustibles
 - Class B – flammable liquids and gases
 - Class C – energized electrical equipment
 - Class D – combustible metals
 - Class K (American system) / Class F (European/Australian systems) – cooking oils and greases



Extinguishing Fires

- How fire extinguishers work

- Remove heat
- Displace/remove oxygen
- Stop chemical reaction



Extinguishing Fires

- Parts of a fire extinguisher and labels



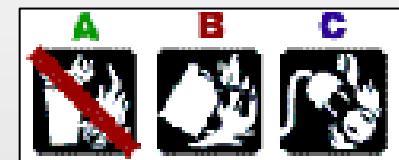
Extinguishing Fires

- Water or air-pressurized water (APW) extinguishers
 - Designed for **Class A fires only**
 - Large silver container, 2 (61cm) to 3 (91.5cm) ft. tall, weighing about 25 lbs. (11.3kg) when full
 - Filled 2/3 with ordinary water, then pressurized with air
 - Detergents may be added
 - Cool the surface to remove the heat
 - **Never use to extinguish flammable liquid fires or electrical fires**



Extinguishing Fires

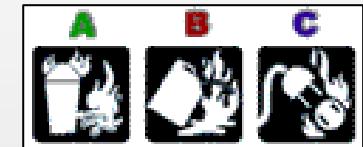
- Carbon Dioxide (CO₂) extinguishers
 - Designed for **Class B and Class C fires only**
 - Red cylinders, ranging from 5 (2.3kg) to 100 (45.4) lbs. or larger, with a hard horn and no pressure gauge
 - Filled with Carbon Dioxide (CO₂), under extreme pressure
 - Displace oxygen; dry ice pieces also have cooling effect
 - **Never use in confines space without respiratory protection**



Extinguishing Fires

- Dry Chemical extinguishers (Multi-purpose)

- May be used on **Class A, Class B, and/or Class C** fires (check label)
- Red cylinders, ranging in size from 5 (2.3kg) to 20 (9.1kg) lbs.
- Fire-retardant powder is the extinguishing agent and is propelled by a compressed, non-flammable gas
- Separates fuel from oxygen; powder also interrupts chemical reaction



Extinguishing Fires

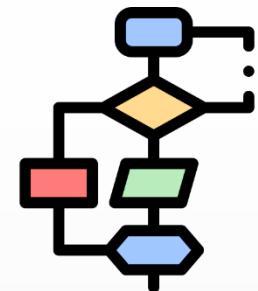
- Class K (American system) / Class F (European/Australian systems) – dry and wet chemical extinguishers
 - Designed for **kitchen fires**
 - Only intended to be used after activation of built-in hood suppression system
 - Filled with electrically conductive extinguishing agents; use only after electrical power to appliance has been shut off
 - Potassium bicarbonate may be used in dry types; wet chemical extinguishers spray a fine mist



Extinguishing Fires

- Using a fire extinguisher: Steps to follow

1. Sound alarm; call fire department
2. Identify safe evacuation path
3. Select appropriate fire extinguisher
4. Discharge extinguisher using P.A.S.S. technique (pull, aim, squeeze, sweep)
5. Back away once extinguished
6. Evacuate immediately if necessary
 - Extinguisher empty and fire is not out
 - Fire progresses beyond incipient stage



Extinguishing Fires

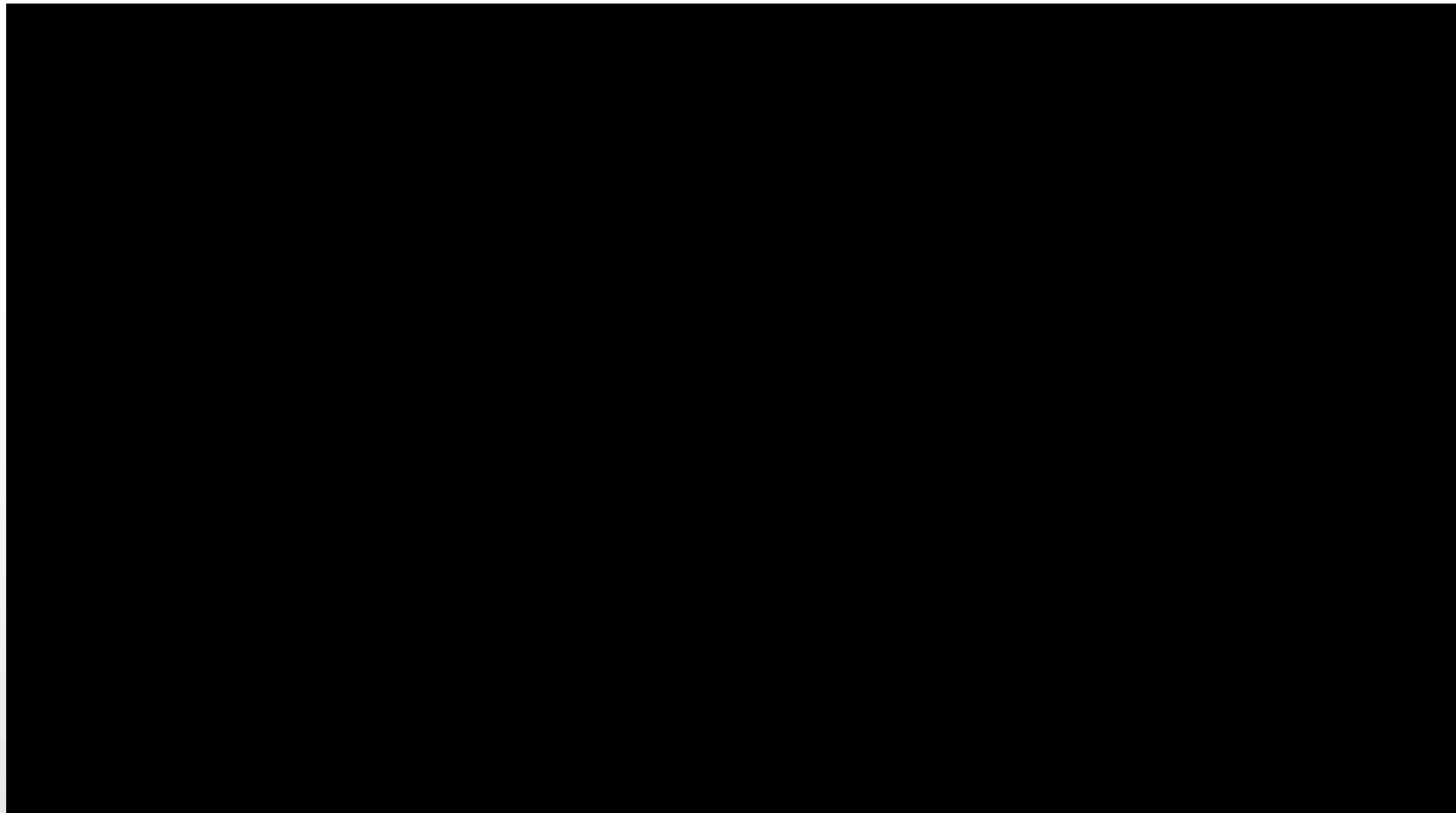


- P.A.S.S.

- **PULL** THE PIN - This unlocks the operating lever and allows you to discharge the extinguisher. Some extinguishers may have other lever-release mechanisms.
- **AIM** LOW - Point the extinguisher nozzle (or hose) at the base of the fire
- **SQUEEZE** THE LEVER ABOVE THE HANDLE - This discharges the extinguishing agent. Releasing the lever will stop the discharge. (Some extinguishers have a button instead of a lever.)
- **SWEEP** FROM SIDE TO SIDE - Moving carefully toward the fire, keep the extinguisher aimed at the base of the fire and sweep back and forth until the flames appear to be out. Watch the fire area. If the fire re-ignites, repeat the process.

Extinguishing Fires

- How to use a Fire Extinguisher



Maintenance of Extinguisher

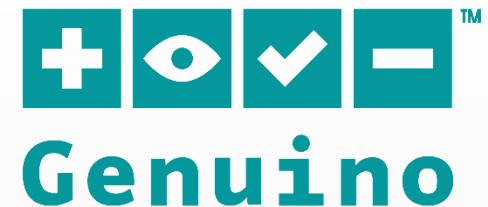


- Elements of inspection

- Inspect bottle, handle, hose, and gauge for proper working order
- Inspection tag
 - Month and Year put in service current (annual)
 - Monthly visual inspections completed (monthly)
 - Extinguisher product still free-flowing inside bottle (turn upside down and/or shake)

Fire alarm system based on Arduino Mega and Ethernet boards, LED, DHT11 temperature and humidity sensor

- Hardware: Arduino Mega/Uno and Ethernet boards, LED, DHT11 temperature/humidity sensor (the network switch is optional)
- Software: Arduino IDE
- Arduino sketch development:
 - Identify the IP address of the Arduino Ethernet shield
 - Develop the Arduino sketch with a simple web-server: The fire alarm message is shown on the screen if the temperature is larger than the specified one, e.g., 45°C
 - Start webpage in the web browser



Fire alarm system based on Arduino Mega and Ethernet boards, LED, DHT11 temperature and humidity sensor

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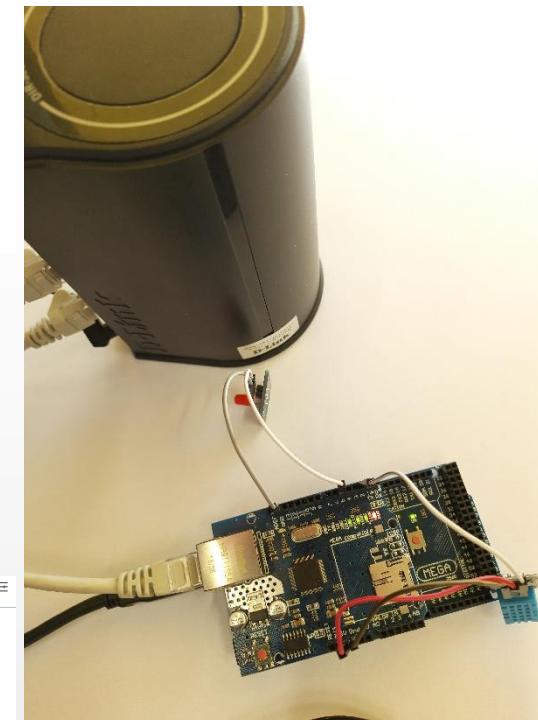
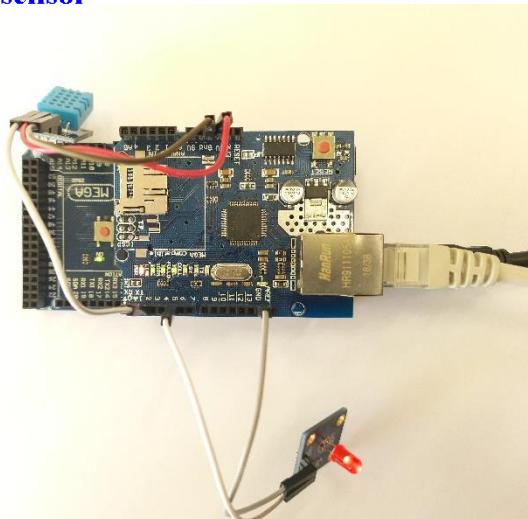
Arduino - An example on the fire safety management with DHT11 temperature and humidity sensor

We can switch on/off LED remotely :)

[Pin 5 is ON](#) [Pin 5 is OFF](#)

Humidity: 17.00

Temperature: 24.00



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Arduino - An example on the fire safety management with DHT11 temperature and humidity sensor

We can switch on/off LED remotely :)

[Pin 5 is ON](#) [Pin 5 is OFF](#)

Humidity: 7.00

Temperature: 46.00

FIRE ALARM: Temperature is HIGH

What's Wrong?



What's Wrong?



Do you have any
questions or
comments?





Thank you
for your attention !



In this presentation:

- Some icons were downloaded from flaticon.com and iconscout.com