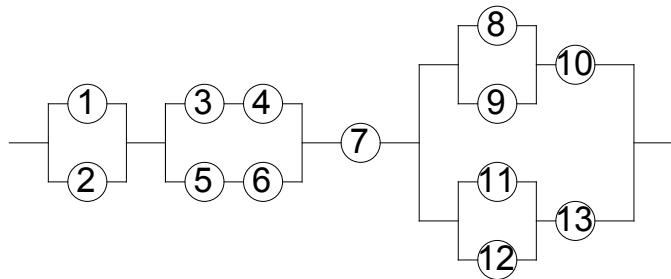


## TestI - 19 Nov 2016 - Exercise I(a) (b)



```

ClearAll["Global`*"]
D = BernoulliDistribution[p];
dists = Table[{xi, D}, {i, 1, 13}];
R = ReliabilityDistribution[(x1 V x2) & ((x3 V x4) V (x5 V x6)) &
    x7 & (((x8 V x9) & x10) V ((x11 V x12) & x13)), dists];
Simplify[Mean[R]]
Simplify[(1 - (1 - p)^2) x (1 - (1 - p^2)^2) x p x (1 - (1 - (1 - (1 - p)^2) x p)^2)]

```

**p = 0.99;**  
**Mean[R]** (\* Calculating the reliability \*)

Out[13]=  $-( -2 + p) p^6 (-2 + p^2) (-4 + 2 p + 4 p^2 - 4 p^3 + p^4)$

Out[14]=  $-( -2 + p) p^6 (-2 + p^2) (-4 + 2 p + 4 p^2 - 4 p^3 + p^4)$

Out[16]= 0.989408

## TestI - 19 Nov 2016 - Exercise 2(a) (adapted)

- 4-out-of-5 system

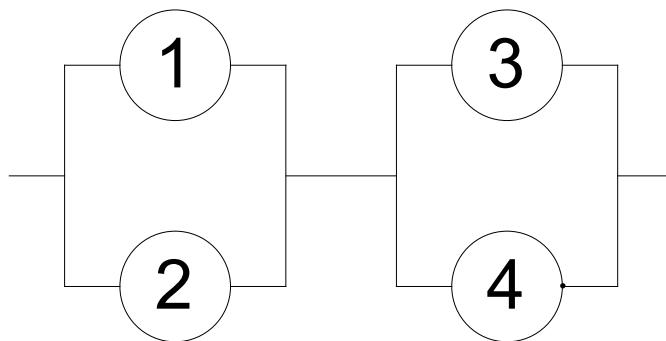
```
In[26]:= ClearAll["Global`*"]
D = WeibullDistribution[2, 1.];
(* Weibull dist. shape and scale param. 2 and 1 *)
dists = Table[{xi, D}, {i, 1, 5}];
R = ReliabilityDistribution[
  (x1 ∨ x2) ∧ (x1 ∨ x3) ∧ (x1 ∨ x4) ∧ (x1 ∨ x5) ∧ (x2 ∨ x3) ∧
   (x2 ∨ x4) ∧ (x2 ∨ x5) ∧ (x3 ∨ x4) ∧ (x3 ∨ x5) ∧ (x4 ∨ x5), dists];
Mean[R] (* Evaluating the expected duration *)

R4OutOf5 = ReliabilityDistribution[
  BooleanCountingFunction[{4, 5}, {x1, x2, x3, x4, x5}], dists];
Mean[R4OutOf5]

N[% , 6]
(* Evaluating the expected duration numerically to 6-digit precision *)

Out[30]= 0.630236
Out[32]= 0.630236
Out[33]=  $\frac{1}{20} \left( 25 - 8\sqrt{5} \right) \sqrt{\pi}$ 
Out[34]= 0.630236
```

## TestRecI - 11 Fev 2017 - Exercise 1(a)

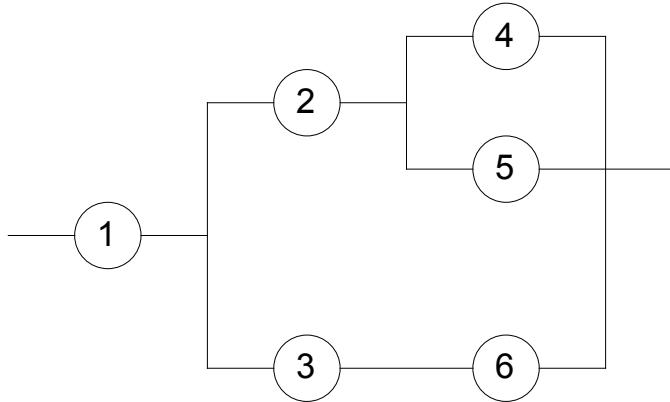


```
In[42]:= ClearAll["Global`*"]
D = BernoulliDistribution[p];
dists = Table[{xi, D}, {i, 1, 4}];
R = ReliabilityDistribution[
  (x1 ∨ x2) ∧ (x3 ∨ x4), dists];
Simplify[Mean[R]]

p = 0.9;
Mean[R]

Out[46]= (-2 + p)2 p2
Out[48]= 0.9801
```

## EpEspecial - 24 Jul 2017 - Exercise 1(a)(b)



```
In[49]:= ClearAll["Global`*"]
dists = Table[{xi, BernoulliDistribution[pi]}, {i, 1, 6}];
R = ReliabilityDistribution[x1 &gt;gt; ((x2 &gt;gt; (x4 &gt;gt; x5)) &lt;>gt; (x3 &gt;gt; x6)), dists];
Expand[Mean[R]]
```

```
For[i = 1, i < 7, i++, pi = 0.99]
Mean[R]
```

Out[52]=  $p_1 p_2 p_4 + p_1 p_2 p_5 - p_1 p_2 p_4 p_5 + p_1 p_3 p_6 - p_1 p_2 p_3 p_4 p_6 - p_1 p_2 p_3 p_5 p_6 + p_1 p_2 p_3 p_4 p_5 p_6$

Out[54]= 0.989801

## EpEspecial - 24 Jul 2017 - Exercise 2(a)(b) - 3-out-of-4 system

```
In[55]:= ClearAll["Global`*"]
λ[t_] = (t/4)^3;
R[t_] = Exp[-Integrate[λ[s], {s, 0, t}]];
N[Integrate[R[t], {t, 0, ∞}], 6] (* Expected life of a component *)
R[%]

D = WeibullDistribution[4, 4.];
dists = Table[{xi, D}, {i, 1, 4}];
R3OutOf4 = ReliabilityDistribution[
    BooleanCountingFunction[{3, 4}, {x1, x2, x3, x4}], dists];
Mean[R3OutOf4] (*Expected life of a 3-out-of-4 system*)
```

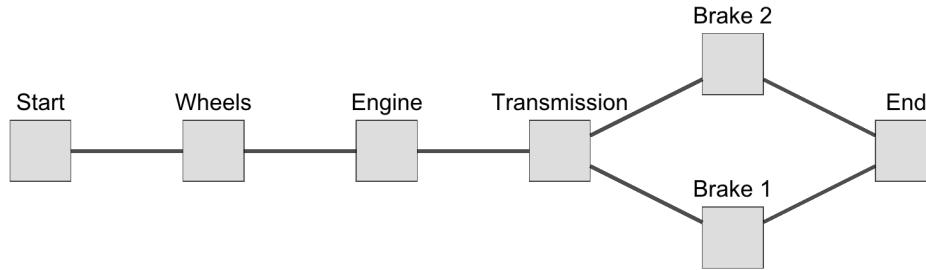
Out[57]=  $e^{-\frac{t^4}{256}}$

Out[58]= 3.62561

Out[59]= 0.50917

Out[63]= 3.32839

## Reliability of a Car



```

ClearAll["Global`*"]
Rcar = ReliabilityDistribution[wheels \[And] engine \[And] transmission \[And] (brake1 \[Or] brake2),
  {{wheels, ExponentialDistribution[\lambda1]}, {engine, WeibullDistribution[a1, b1]},
   {transmission, ExponentialDistribution[\lambda2]}, {brake1,
   ExponentialDistribution[\lambda3]}, {brake2, ExponentialDistribution[\lambda3]}}]];
  
```

Compute the survival function:

$$\text{SurvivalFunction}[Rcar, t] = \begin{cases} 1 & t < 0 \\ e^{-t\lambda_1-t\lambda_2} \left(1 - (1 - e^{-t\lambda_3})^2\right) & t == 0 \\ e^{-\left(\frac{t}{b_1}\right)a_1-t\lambda_1-t\lambda_2} \left(1 - (1 - e^{-t\lambda_3})^2\right) & \text{True} \end{cases}$$

Without maintenance, the expected lifetime is about three years:

```

vals = {\lambda1 \[Rule] 1/5, \lambda2 \[Rule] 1/10, \lambda3 \[Rule] 1/15, a1 \[Rule] 5, b1 \[Rule] 12};
mttf = NExpectation[t, t \[Approximate] Rcar /. vals]
3.03247
  
```

**Explore Help/Wolfram Documentation/Reliability:**

- example/SurveilanceCameraReliability
- example/DataCenterReliability
- example/ReliabilityOfASpaceLaunch
- example/CompareReliabilityOfSystemConfigurations