# MOwNiT

# Lab3 interpolacja

In [1]:

```
using Plots
using Polynomials
using DataFrames
using Statistics
using Interpolations
```

# Zad1

In [2]:

```
function Counter(X, i, x)
    n = size(X)[1]
    differences = []
    for k=1:n
        if k != i
            append!(differences, x - X[k])
        end
    end
    result = 1
    for diff in differences
        result *= diff
    end
    return result
end

function Denominator(X, i)
    differences = []
    for x in X
        if x != X[i]
            append!(differences, X[i] - x)
        end
    end
    result = 1
    for diff in differences
        result *= diff
    end
    return result
end

function LagrangeInterpolation(X, Y)
    n = size(X)[1]

    denominators_arr = [Denominator(X, i) for i=1:n]
    x_interpolation = [x for x=X[1]:0.01:X[n]]
    y_interpolation = []
    for x in x_interpolation
        Counters_arr = []
        for i=1:n
            append!(Counters_arr, Counter(X, i, x))
        end
        y_value = 0
        for i=1:n
            y_value += Y[i] * Counters_arr[i] / denominators_arr[i]
        end
        append!(y_interpolation, y_value)
    end
    return x_interpolation , y_interpolation
end
```

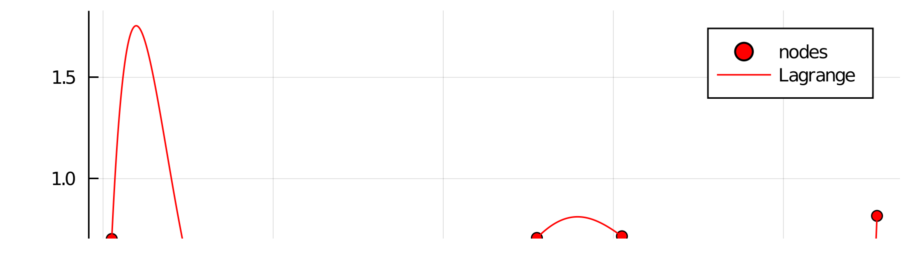
Out[2]:

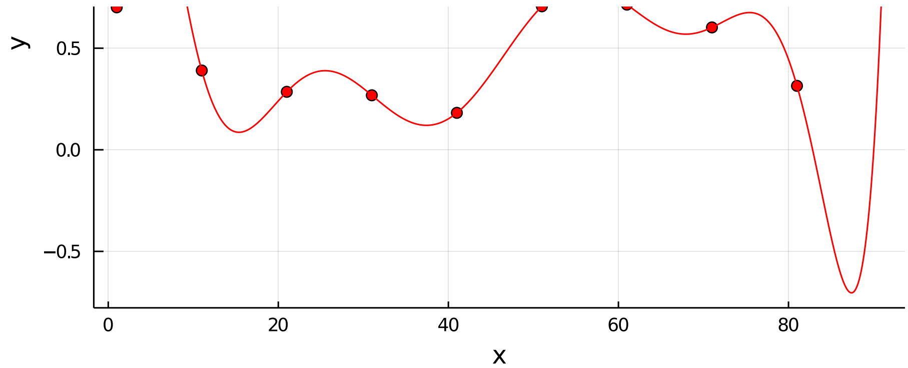
```
LagrangeInterpolation (generic function with 1 method)
```

In [3]:

```
X = 1:10:100
Y = [rand() for x in X]
plot(X, Y, seriestype = :scatter, color = :red, label = "nodes")
plot!(LagrangeInterpolation(X, Y), color = :red, label = "Lagrange", xaxis = "x", yaxis = "y")
```

Out[3]:






# Zad2

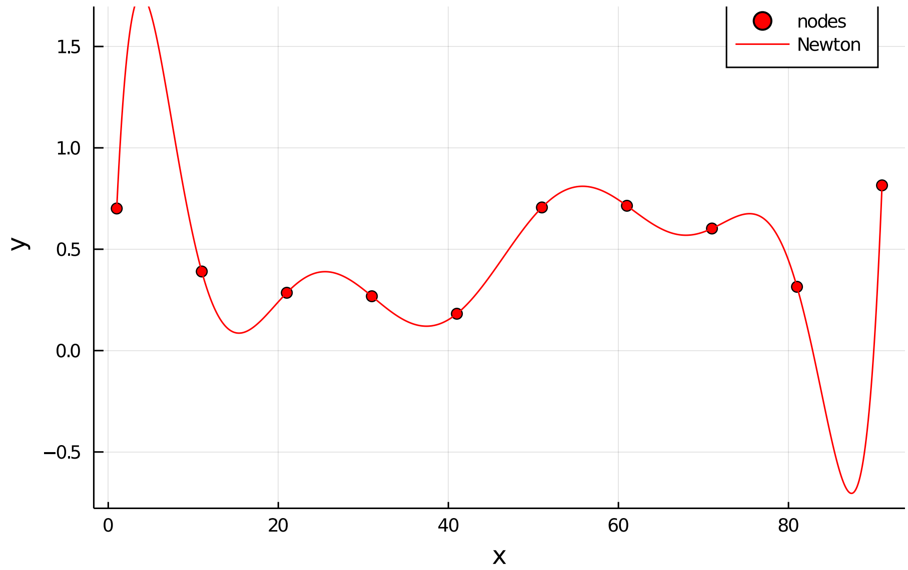
In [4]:
```
struct newt
    NewtonDifferences::Array{Any, 1}
    X::Array{Float64, 1}
    Y::Array{Float64, 1}
end
```

In [5]:
```
function NewtonDifferences(X, Y)
    n = size(X)[1]
    differences = []

    for i=1:n
        for j=1:i
            if j == 1
                push!(differences, [])
                append!(differences[i], Y[i])
            else
                append!(differences[i], (differences[i][j-1] - differences[i-1][j-1]) / (X[i] - X[i-j+1]))
            end
        end
    end
    return differences
end

function NewtonInterpolation(X, Y)
    return newt(NewtonDifferences(X,Y), X, Y)
end

function Horner_schema_Newton(newt, x)
    NewtonDifferences = newt.NewtonDifferences

    X = newt.X
    n = size(X)[1]

    value = NewtonDifferences[n][n]

    for i=(n-1):-1:1
        value = value * (x - X[i]) + NewtonDifferences[i][i]
    end

    return value
end

function N_Interpolation(nodes, Y)
    n = size(nodes)[1]
    x_interpolation = [x for x=nodes[1]:0.01:nodes[n]]
    y_interpolation = []

    newt = NewtonInterpolation(nodes, Y)

    for x in x_interpolation
        append!(y_interpolation, Horner_schema_Newton(newt, x))
    end

    return x_interpolation, y_interpolation

end
```

Out[5]: N_Interpolation (generic function with 1 method)

In [6]:
```
plot(X, Y, seriestype = :scatter, color = :red, label = "nodes")
plot!(N_Interpolation(X,Y), color = :red, label = "Newton", xaxis = "x", yaxis = "y")
```

Out[6]:



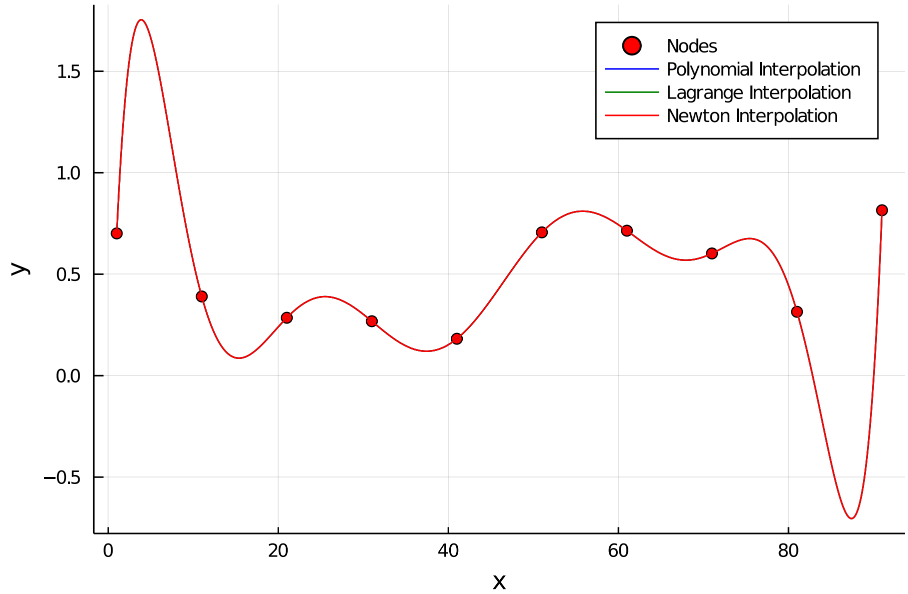

# Zad3

In [7]:
```
function PolynomialInterpolation(X, Y)
    n = size(X)[1]
    itp = fit(X, Y)
    x_interpolation = [i for i=X[1]:0.01:X[n]]
    y_interpolation = []
    for x in x_interpolation
        append!(y_interpolation, itp(x))
    end
    return x_interpolation, y_interpolation
end
```

Out[7]:
```
PolynomialInterpolation (generic function with 1 method)
```

In [8]:
```
plot(X,Y, color = :red, seriestype = :scatter, label = "Nodes", xaxis = "x", yaxis = "y")
plot!(PolynomialInterpolation(X,Y), color = :blue, label = "Polynomial Interpolation")
plot!(LagrangeInterpolation(X, Y), color = :green , label = "Lagrange Interpolation")
plot!(N_Interpolation(X,Y), color = :red, label = "Newton Interpolation")
```

Out[8]:




# Zad 4

In [9]:
```
times = []
for j=1:5
    push!(times, [])
    for i=10:10:200
        X = 1:i
```

```
        Y = [rand() for x in X]
        for k=1:10
            if j == 1
                append!(times[j], @elapsed PolynomialInterpolation(X,Y))
            elseif j == 2
                append!(times[j], @elapsed LagrangeInterpolation(X,Y))
            elseif j == 3
                append!(times[j], @elapsed N_Interpolation(X,Y))
            elseif j == 4
                if i == 10 && k == 1
                    push!(times, [])
                end
                newt_obj = NewtonInterpolation(X,Y)
                append!(times[j], @elapsed NewtonInterpolation(X,Y))
                append!(times[j+1], @elapsed [Horner_schema_Newton(newt_obj, x) for x in X[1]:0.01:X[i]])
            elseif j == 5
                if i == 10 && k == 1
                    push!(times, [])
                end
                itp = fit(X,Y)
                append!(times[j+1], @elapsed fit(X,Y))
                append!(times[j+2], @elapsed [itp(x) for x in X[1]:0.01:X[i]])
            end
        end
    end
end
```

# Polynomials Lagrange Newton Interpolation times

In [10]:

```
df = DataFrame()
types = ["Polynomials" "Lagrange" "Newton"]
df[:, :Type] = [types[i] for i=1:3 for j=1:200]
df[:, :Size] = [i for j=1:3 for i=10:10:200 for k=1:10]
df[:, :Time] = [times[j][i] for j=1:3 for i=1:200]
df
```

Out[10]: 600 rows × 3 columns

| | Type | Size | Time |
|---|---|---|---|
| | String | Int64 | Float64 |
| 1 | Polynomials | 10 | 0.0516305 |
| 2 | Polynomials | 10 | 3.9899e-5 |
| 3 | Polynomials | 10 | 4.21e-5 |
| 4 | Polynomials | 10 | 3.7999e-5 |
| 5 | Polynomials | 10 | 3.85e-5 |
| 6 | Polynomials | 10 | 3.94e-5 |
| 7 | Polynomials | 10 | 4.15e-5 |
| 8 | Polynomials | 10 | 4.0401e-5 |
| 9 | Polynomials | 10 | 3.9599e-5 |
| 10 | Polynomials | 10 | 4.2399e-5 |
| 11 | Polynomials | 20 | 9.65e-5 |
| 12 | Polynomials | 20 | 9.3199e-5 |
| 13 | Polynomials | 20 | 0.0001027 |
| 14 | Polynomials | 20 | 9.9101e-5 |
| 15 | Polynomials | 20 | 9.27e-5 |
| 16 | Polynomials | 20 | 0.0001052 |
| 17 | Polynomials | 20 | 9.83e-5 |
| 18 | Polynomials | 20 | 9.3301e-5 |
| 19 | Polynomials | 20 | 9.3201e-5 |
| 20 | Polynomials | 20 | 9.75e-5 |
| 21 | Polynomials | 30 | 0.000164799 |
| 22 | Polynomials | 30 | 0.0001653 |
| 23 | Polynomials | 30 | 0.000165801 |
| 24 | Polynomials | 30 | 0.0001624 |
| 25 | Polynomials | 30 | 0.000161701 |
| 26 | Polynomials | 30 | 0.000193399 |
| 27 | Polynomials | 30 | 0.0001606 |

| | | | |
|---|---|---|---|
| **28** | Polynomials | 30 | 0.0001607 |
| **29** | Polynomials | 30 | 0.0001594 |
| **30** | Polynomials | 30 | 0.0001614 |
| **⋮** | ⋮ | ⋮ | ⋮ |

# Polynomials Newton differences and values times

In [11]:

```
df_2 = DataFrame()
types_2 = ["Newton" "Polynomials"]
df_2[:, :Type] = [types_2[i] for i=1:2 for j=1:200]
df_2[:, :Size] = [i for j=1:2 for i=10:10:200 for k=1:10]
df_2[:, :Diff_time] = [times[j][i] for j=4:2:6 for i=1:200]
df_2[:, :Val_time] = [times[j][i] for j=5:2:7 for i=1:200]
df_2
```

Out[11]: 400 rows × 4 columns

| | Type | Size | Diff_time | Val_time |
|---|---|---|---|---|
| | String | Int64 | Float64 | Float64 |
| **1** | Newton | 10 | 9.401e-6 | 0.0661144 |
| **2** | Newton | 10 | 7.0e-6 | 0.0013418 |
| **3** | Newton | 10 | 1.9899e-5 | 0.0009139 |
| **4** | Newton | 10 | 7.8e-6 | 0.0006868 |
| **5** | Newton | 10 | 7.0e-6 | 0.0008901 |
| **6** | Newton | 10 | 1.34e-5 | 0.0015347 |
| **7** | Newton | 10 | 1.78e-5 | 0.0011571 |
| **8** | Newton | 10 | 1.26e-5 | 0.000799101 |
| **9** | Newton | 10 | 6.7e-6 | 0.0005472 |
| **10** | Newton | 10 | 7.0e-6 | 0.0005351 |
| **11** | Newton | 20 | 2.4201e-5 | 0.0557142 |
| **12** | Newton | 20 | 2.51e-5 | 0.0030451 |
| **13** | Newton | 20 | 6.2901e-5 | 0.0056353 |
| **14** | Newton | 20 | 2.4601e-5 | 0.0028229 |
| **15** | Newton | 20 | 2.4399e-5 | 0.0023274 |
| **16** | Newton | 20 | 2.42e-5 | 0.0022566 |
| **17** | Newton | 20 | 2.4201e-5 | 0.0024594 |
| **18** | Newton | 20 | 4.5499e-5 | 0.0042213 |
| **19** | Newton | 20 | 5.92e-5 | 0.0028098 |
| **20** | Newton | 20 | 2.4e-5 | 0.0028235 |
| **21** | Newton | 30 | 5.1901e-5 | 0.0058972 |
| **22** | Newton | 30 | 5.3701e-5 | 0.0078524 |
| **23** | Newton | 30 | 7.2899e-5 | 0.0059929 |
| **24** | Newton | 30 | 5.4599e-5 | 0.0096381 |
| **25** | Newton | 30 | 9.96e-5 | 0.0063963 |
| **26** | Newton | 30 | 5.4701e-5 | 0.008899 |
| **27** | Newton | 30 | 0.0001005 | 0.0067772 |
| **28** | Newton | 30 | 5.83e-5 | 0.0106063 |
| **29** | Newton | 30 | 0.000102 | 0.0064094 |
| **30** | Newton | 30 | 5.5001e-5 | 0.0080143 |
| **⋮** | ⋮ | ⋮ | ⋮ | ⋮ |

# Statistics

In [12]:

```
df_grouped = groupby(df, [:Type, :Size])
df_stats = combine(df_grouped, "Time" => mean, "Time" => std)
```

Out[12]: 60 rows × 4 columns

| | Type | Size | Time_mean | Time_std |
|---|---|---|---|---|
| | String | Int64 | Float64 | Float64 |
| 1 | Polynomials | 10 | 0.00519923 | 0.0163143 |
| 2 | Polynomials | 20 | 9.71702e-5 | 4.30887e-6 |
| 3 | Polynomials | 30 | 0.00016555 | 1.00226e-5 |
| 4 | Polynomials | 40 | 0.00030051 | 9.56702e-6 |
| 5 | Polynomials | 50 | 0.00053536 | 0.000217286 |
| 6 | Polynomials | 60 | 0.00164456 | 0.00326946 |
| 7 | Polynomials | 70 | 0.0006678 | 2.49893e-5 |
| 8 | Polynomials | 80 | 0.00095037 | 0.000241634 |
| 9 | Polynomials | 90 | 0.00112235 | 4.95579e-5 |
| 10 | Polynomials | 100 | 0.00152197 | 0.00045959 |
| 11 | Polynomials | 110 | 0.00175651 | 0.000379228 |
| 12 | Polynomials | 120 | 0.00221246 | 0.000446468 |
| 13 | Polynomials | 130 | 0.00227341 | 0.00023123 |
| 14 | Polynomials | 140 | 0.00267164 | 0.000462139 |
| 15 | Polynomials | 150 | 0.00409408 | 0.00371634 |
| 16 | Polynomials | 160 | 0.00336308 | 0.000415606 |
| 17 | Polynomials | 170 | 0.00391856 | 0.00048112 |
| 18 | Polynomials | 180 | 0.00452808 | 0.000697914 |
| 19 | Polynomials | 190 | 0.00463997 | 0.00046613 |
| 20 | Polynomials | 200 | 0.00777299 | 0.00264348 |
| 21 | Lagrange | 10 | 0.0167868 | 0.0321269 |
| 22 | Lagrange | 20 | 0.0555901 | 0.00515628 |
| 23 | Lagrange | 30 | 0.186713 | 0.0298955 |
| 24 | Lagrange | 40 | 0.548725 | 0.0694794 |
| 25 | Lagrange | 50 | 0.767327 | 0.0317881 |
| 26 | Lagrange | 60 | 1.23605 | 0.00983517 |
| 27 | Lagrange | 70 | 2.34258 | 0.0533412 |
| 28 | Lagrange | 80 | 3.34547 | 0.0263944 |
| 29 | Lagrange | 90 | 4.70849 | 0.121274 |
| 30 | Lagrange | 100 | 6.29273 | 0.0568486 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |

In [13]:
```
df_2_grouped = groupby(df_2, [:Type, :Size])
df_2_stats = combine(df_2_grouped, "Diff_time"=>mean , "Val_time"=>mean, "Diff_time"=>std, "Val_time"=>std)
```

Out[13]: 40 rows × 6 columns

| | Type | Size | Diff_time_mean | Val_time_mean | Diff_time_std | Val_time_std |
|---|---|---|---|---|---|---|
| | String | Int64 | Float64 | Float64 | Float64 | Float64 |
| 1 | Newton | 10 | 1.086e-5 | 0.00745202 | 4.86305e-6 | 0.0206145 |
| 2 | Newton | 20 | 3.38302e-5 | 0.00841155 | 1.58116e-5 | 0.0166526 |
| 3 | Newton | 30 | 7.03202e-5 | 0.00764831 | 2.17668e-5 | 0.00163696 |
| 4 | Newton | 40 | 0.00010556 | 0.0183793 | 2.83474e-5 | 0.0163522 |
| 5 | Newton | 50 | 0.0001492 | 0.030695 | 1.33675e-5 | 0.021512 |
| 6 | Newton | 60 | 0.0002867 | 0.0419408 | 0.000103973 | 0.019774 |
| 7 | Newton | 70 | 0.00040598 | 0.0557511 | 0.000153489 | 0.0203899 |
| 8 | Newton | 80 | 0.00054653 | 0.0816488 | 0.000327804 | 0.0277105 |
| 9 | Newton | 90 | 0.00056728 | 0.0930716 | 0.000178611 | 0.0288786 |
| 10 | Newton | 100 | 0.00090965 | 0.109373 | 0.000383787 | 0.0244169 |
| 11 | Newton | 110 | 0.00080861 | 0.140708 | 0.000201519 | 0.0291621 |
| 12 | Newton | 120 | 0.001308 | 0.172718 | 0.000840913 | 0.0226628 |
| 13 | Newton | 130 | 0.00111267 | 0.202242 | 0.000377066 | 0.0129412 |
| 14 | Newton | 140 | 0.00165132 | 0.230497 | 0.00046233 | 0.014369 |
| 15 | Newton | 150 | 0.00637081 | 0.25566 | 0.0150161 | 0.0213122 |

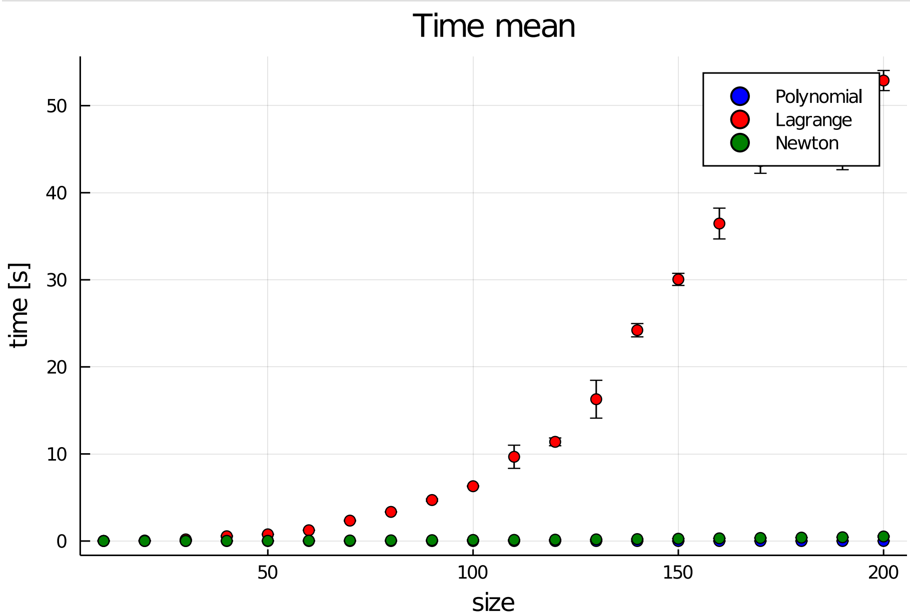
| | | | | | | |
|---|---|---|---|---|---|---|
| **16** | Newton | 160 | 0.00184728 | 0.2932 | 0.000578907 | 0.028483 |
| **17** | Newton | 170 | 0.00237291 | 0.344249 | 0.00104914 | 0.0393247 |
| **18** | Newton | 180 | 0.0081971 | 0.365459 | 0.016621 | 0.0272996 |
| **19** | Newton | 190 | 0.0080042 | 0.411028 | 0.0164248 | 0.0256505 |
| **20** | Newton | 200 | 0.00369178 | 0.559345 | 0.0018483 | 0.097186 |
| **21** | Polynomials | 10 | 1.6199e-6 | 0.00462146 | 1.17016e-6 | 0.0145399 |
| **22** | Polynomials | 20 | 1.8901e-6 | 5.33298e-5 | 5.48577e-7 | 9.03534e-6 |
| **23** | Polynomials | 30 | 3.07e-6 | 0.0219506 | 1.0688e-6 | 0.0690617 |
| **24** | Polynomials | 40 | 4.87e-6 | 0.00017545 | 1.73397e-6 | 1.48788e-5 |
| **25** | Polynomials | 50 | 6.4e-6 | 0.00028693 | 1.53993e-6 | 2.55265e-5 |
| **26** | Polynomials | 60 | 1.03598e-5 | 0.00047793 | 2.52399e-6 | 9.20273e-5 |
| **27** | Polynomials | 70 | 1.21601e-5 | 0.00053641 | 3.87635e-6 | 3.10805e-5 |
| **28** | Polynomials | 80 | 2.153e-5 | 0.00100622 | 1.28185e-5 | 0.000599 |
| **29** | Polynomials | 90 | 1.70701e-5 | 0.00093622 | 4.56095e-6 | 7.02975e-5 |
| **30** | Polynomials | 100 | 1.87901e-5 | 0.00112806 | 2.93134e-6 | 0.000123014 |
| ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ | ⋮ |

# Plots

In [14]:

```
df_polynomials = df_stats[1:20, :]
df_lagrange = df_stats[21:40, :]
df_newton = df_stats[41:60, :]
plot(df_polynomials.Size, df_polynomials.Time_mean, colour = :blue,label="Polynomial",
    yerr=df_polynomials.Time_std, seriestype=:scatter,ylabel = "time [s]",xlabel = "size", layout = 1)

plot!(df_lagrange.Size, df_lagrange.Time_mean, colour = :red,label="Lagrange",
    yerr=df_lagrange.Time_std,seriestype=:scatter,ylabel = "time [s]",xlabel = "size", layout = 1)

plot!(df_newton.Size, df_newton.Time_mean, colour = :green, title="Time mean",label="Newton",
    yerr=df_newton.Time_std,seriestype=:scatter,ylabel = "time [s]",xlabel = "size", layout = 1)
```

Out[14]:

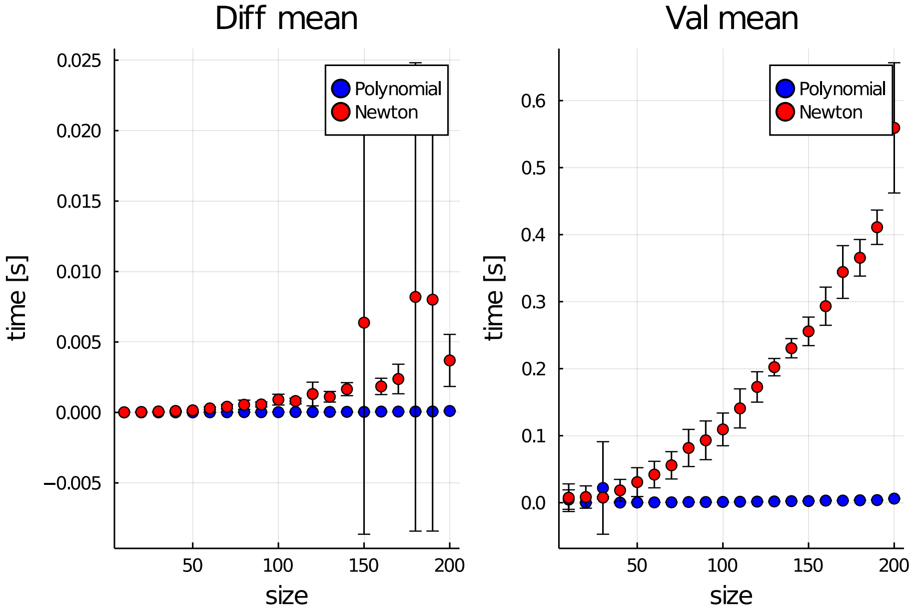



In [15]:

```
df_2_polynomials = df_2_stats[21:40, :]
df_2_newton = df_2_stats[1:20, :]

plot(df_2_polynomials.Size, df_2_polynomials.Diff_time_mean, colour = :blue,label="Polynomial",
    yerr=df_2_polynomials.Diff_time_std, seriestype=:scatter, layout = 1)

p1 = plot!(df_2_newton.Size, df_2_newton.Diff_time_mean, colour = :red, title="Diff mean",label="Newton",
    yerr=df_2_newton.Diff_time_std,seriestype=:scatter, layout = 1)

plot(df_2_polynomials.Size, df_2_polynomials.Val_time_mean, colour = :blue,label="Polynomial",
    yerr=df_2_polynomials.Val_time_std, seriestype=:scatter, layout = 1)

p2 = plot!(df_2_newton.Size, df_2_newton.Val_time_mean, colour = :red, title="Val mean",label="Newton",
    yerr=df_2_newton.Val_time_std,seriestype=:scatter, layout = 1)
```

```
plot(p1, p2, ylabel = ["time [s]" "time [s]"],xlabel = ["size" "size"],
    layout = 2)
```

Out[15]:

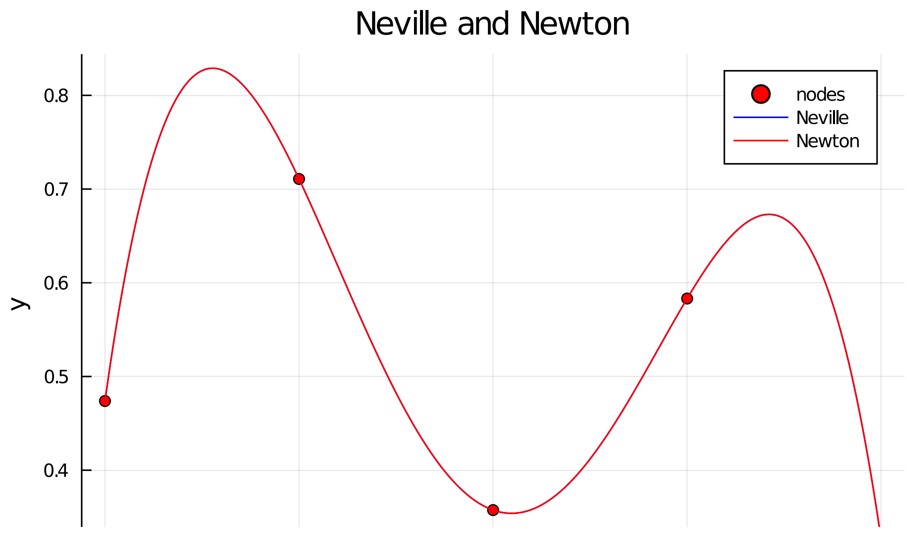


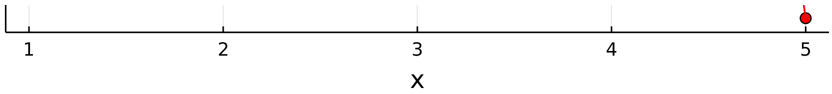

# Zad5 Neville's algorithm

In [16]:

```
function neville_polynomial_value(X,Y,x)
    n = size(X)[1]
    t = []

    for i = 1:n
        push!(t, [])
        append!(t[i], Y[i])
    end
    for i = 2:n
        for j =2:i
            append!(t[i], ((x - X[i-j+1])*t[i][j-1] - (x - X[i])*t[i-1][j-1]) / (X[i] - X[i-j+1]))
        end
    end
    return t[n][n]
end

function neville_algorithm(X,Y)
    n = size(X)[1]
    x_interpolation = [x for x=X[1]:0.01:X[n]]
    y_interpolation = []
    for x in x_interpolation
        append!(y_interpolation, neville_polynomial_value(X,Y,x))
    end
    return x_interpolation, y_interpolation
end

X = [i for i=1:5]
Y = [rand() for x in X]

plot(X, Y, seriestype = :scatter, color = :red, label = "nodes")
plot!(neville_algorithm(X,Y), color = :blue, label = "Neville")
plot!(N_Interpolation(X,Y), color = :red, label = "Newton", xaxis = "x", yaxis = "y", title = "Neville and Newtor
```

Out[16]:






In [17]:
```
x_neville, y_neville = neville_algorithm(X,Y)
x_newton, y_newton = N_Interpolation(X,Y)
df = DataFrame()
df[:, :x] = [x for x in x_neville]
df[:, :y_neville] = y_neville
df[:, :y_newton] = y_newton
df
```

Out[17]: 401 rows × 3 columns

| | x | y_neville | y_newton |
|---|---|---|---|
| | Float64 | Any | Any |
| 1 | 1.0 | 0.473817 | 0.473817 |
| 2 | 1.01 | 0.488426 | 0.488426 |
| 3 | 1.02 | 0.502658 | 0.502658 |
| 4 | 1.03 | 0.516519 | 0.516519 |
| 5 | 1.04 | 0.530013 | 0.530013 |
| 6 | 1.05 | 0.543145 | 0.543145 |
| 7 | 1.06 | 0.555918 | 0.555918 |
| 8 | 1.07 | 0.568337 | 0.568337 |
| 9 | 1.08 | 0.580407 | 0.580407 |
| 10 | 1.09 | 0.592132 | 0.592132 |
| 11 | 1.1 | 0.603516 | 0.603516 |
| 12 | 1.11 | 0.614563 | 0.614563 |
| 13 | 1.12 | 0.625279 | 0.625279 |
| 14 | 1.13 | 0.635666 | 0.635666 |
| 15 | 1.14 | 0.64573 | 0.64573 |
| 16 | 1.15 | 0.655474 | 0.655474 |
| 17 | 1.16 | 0.664903 | 0.664903 |
| 18 | 1.17 | 0.67402 | 0.67402 |
| 19 | 1.18 | 0.682831 | 0.682831 |
| 20 | 1.19 | 0.691339 | 0.691339 |
| 21 | 1.2 | 0.699548 | 0.699548 |
| 22 | 1.21 | 0.707463 | 0.707463 |
| 23 | 1.22 | 0.715086 | 0.715086 |
| 24 | 1.23 | 0.722424 | 0.722424 |
| 25 | 1.24 | 0.729479 | 0.729479 |
| 26 | 1.25 | 0.736255 | 0.736255 |
| 27 | 1.26 | 0.742756 | 0.742756 |
| 28 | 1.27 | 0.748987 | 0.748987 |
| 29 | 1.28 | 0.754952 | 0.754952 |
| 30 | 1.29 | 0.760653 | 0.760653 |
| ⋮ | ⋮ | ⋮ | ⋮ |

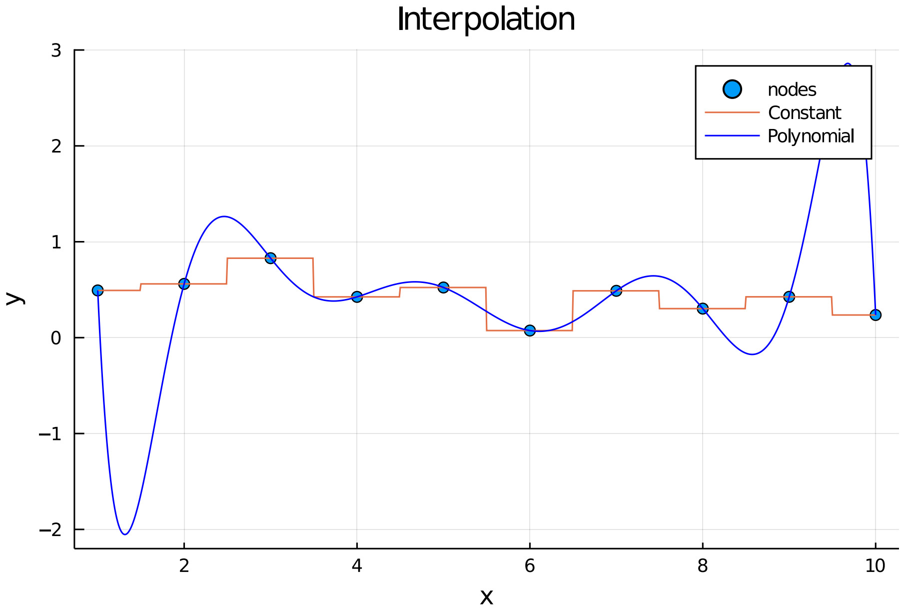
# Zad6

# Bspline Constant and Polynomial

In [18]:
```
X = 1:10
Y = [rand() for x in X]
x_itp = X[1]:0.01:X[10]

itp = interpolate(Y, BSpline(Constant()))
y1= [itp(x) for x in x_itp]
```

```
plot(X, Y, seriestype=:scatter, label="nodes")
plot!(x_itp, y1, label="Constant")
plot!(PolynomialInterpolation(X,Y), color = :blue, label = "Polynomial", title = "Interpolation", xaxis = "x",yax
```

Out[18]:

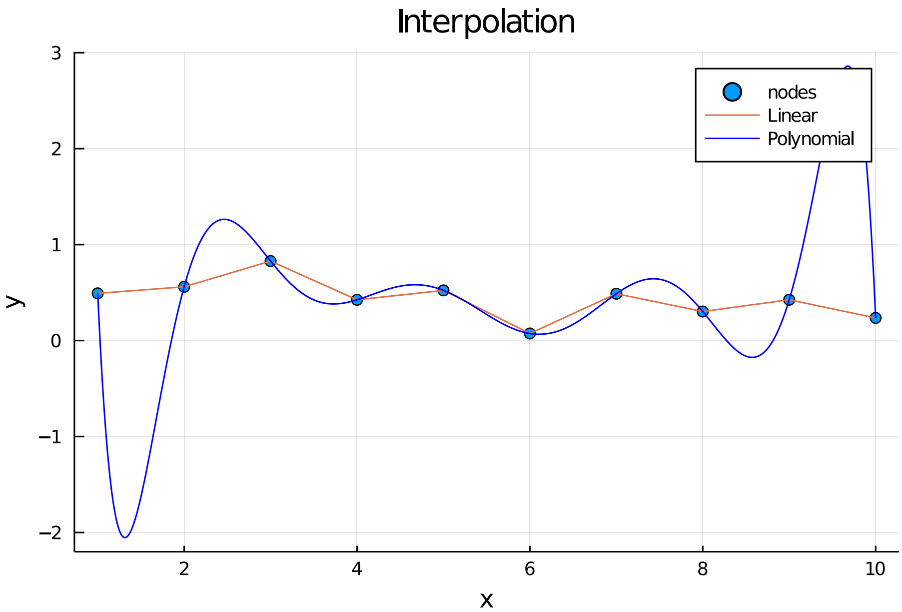



## Bspline Linear and Polynomial

In [19]:

```
itp = interpolate(Y, BSpline(Linear()))
y1= [itp(x) for x in x_itp]

plot(X, Y, seriestype=:scatter, label="nodes")
plot!(x_itp, y1, label="Linear")
plot!(PolynomialInterpolation(X,Y), color = :blue, label = "Polynomial", title = "Interpolation", xaxis = "x",yax
```

Out[19]:

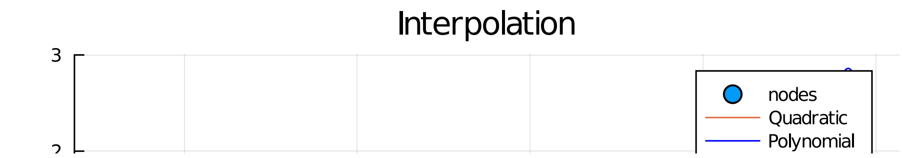


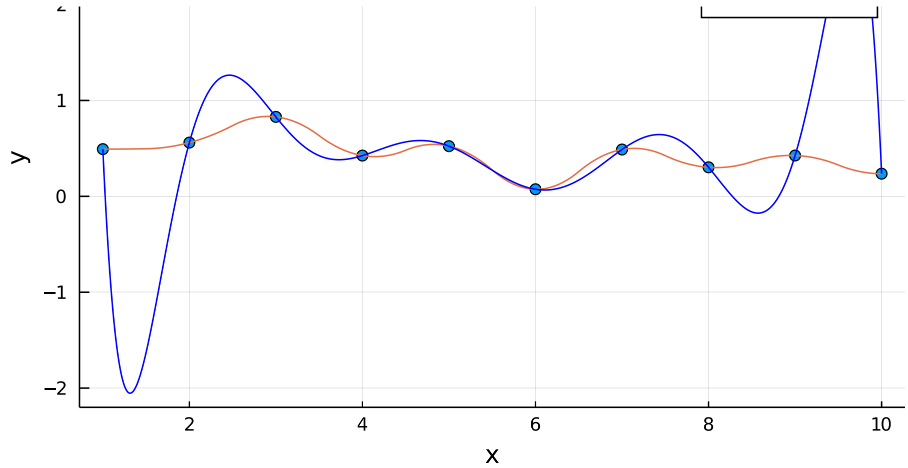

## Bspline Quadratic and Polynomial

In [20]:

```
itp = interpolate(Y, BSpline(Quadratic(Flat(OnGrid()))))
y1= [itp(x) for x in x_itp]

plot(X, Y, seriestype=:scatter, label="nodes")
plot!(x_itp, y1, label="Quadratic")
plot!(PolynomialInterpolation(X,Y), color = :blue, label = "Polynomial", title = "Interpolation", xaxis = "x",yax
```

Out[20]:

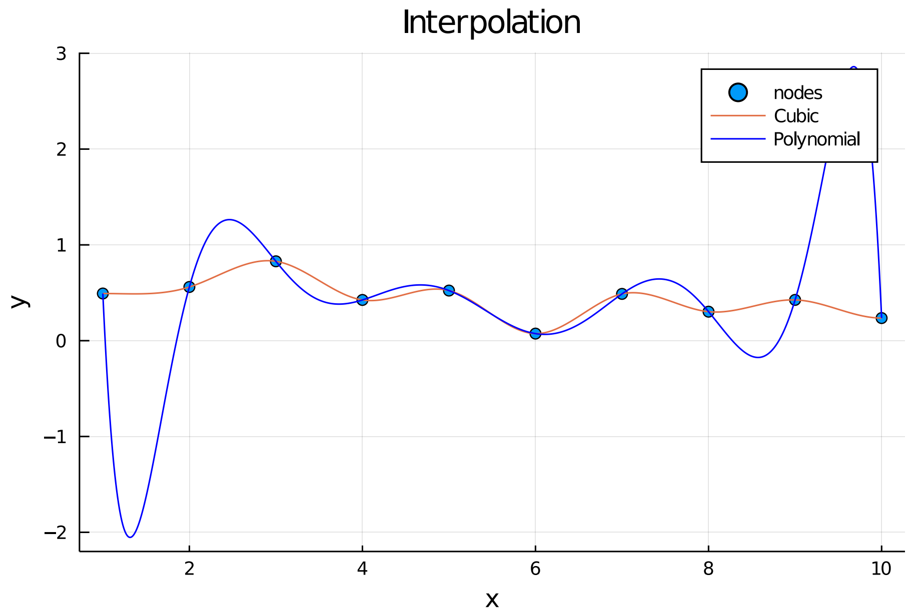





## BSpline Cubic and Polynomial

In [21]:
```
itp = interpolate(Y, BSpline(Cubic(Flat(OnGrid()))))
y1= [itp(x) for x in x_itp]

plot(X, Y, seriestype=:scatter, label="nodes")
plot!(x_itp, y1, label="Cubic")
plot!(PolynomialInterpolation(X,Y), color = :blue, label = "Polynomial", title = "Interpolation", xaxis = "x",yax
```

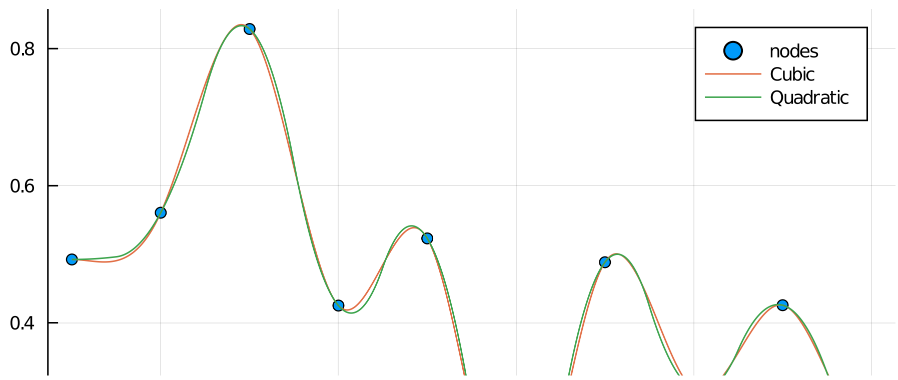
Out[21]:

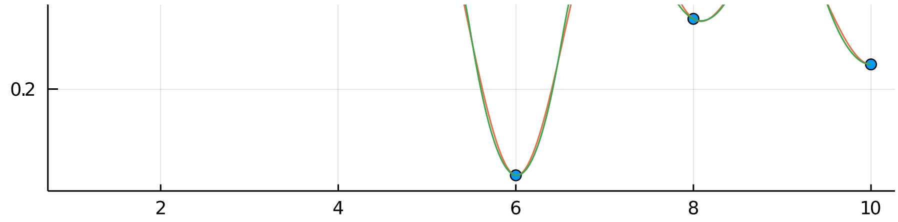



## Quadratic and Cubic

In [22]:
```
plot(X, Y, seriestype=:scatter, label="nodes")
itp = interpolate(Y, BSpline(Cubic(Flat(OnGrid()))))
y1= [itp(x) for x in x_itp]
plot!(x_itp, y1, label="Cubic")
itp = interpolate(Y, BSpline(Quadratic(Flat(OnGrid()))))
y1= [itp(x) for x in x_itp]
plot!(x_itp, y1, label="Quadratic")
```

Out[22]:

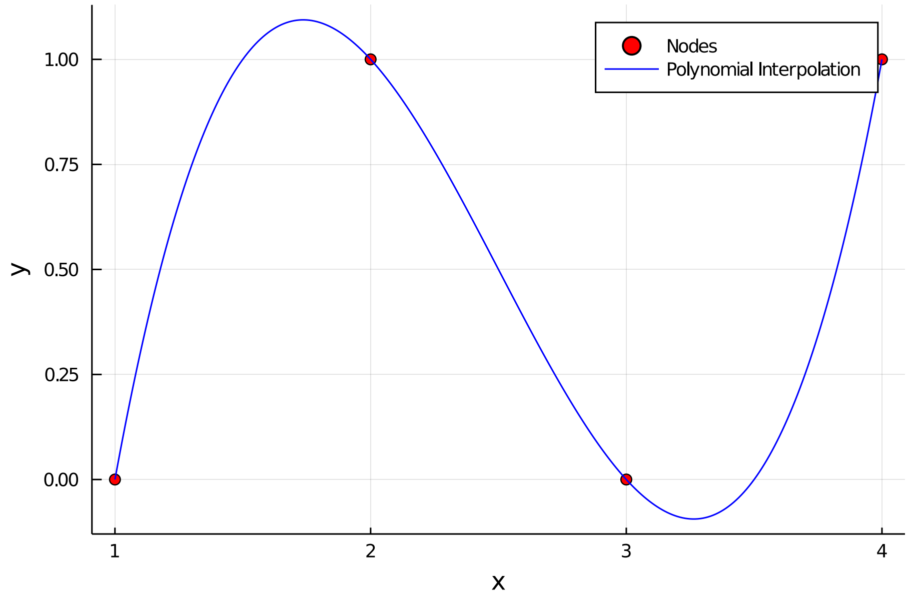





## Efekt Rungego

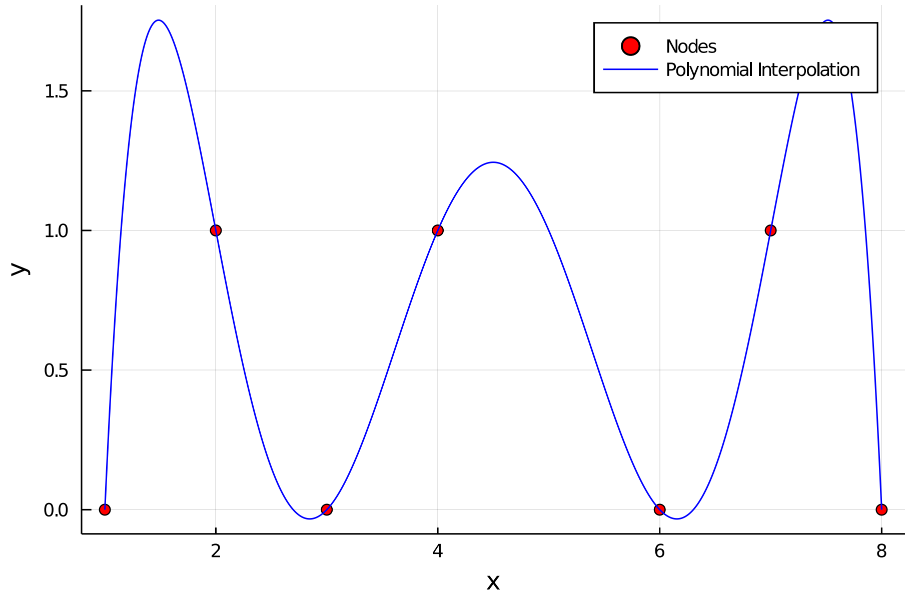
In [23]:
```
X = [i for i=1:4]
Y = [rand(0:1) for x in X]
plot(X,Y, color = :red, seriestype = :scatter, label = "Nodes", xaxis = "x", yaxis = "y")
plot!(PolynomialInterpolation(X,Y), color = :blue, label = "Polynomial Interpolation")
```

Out[23]:



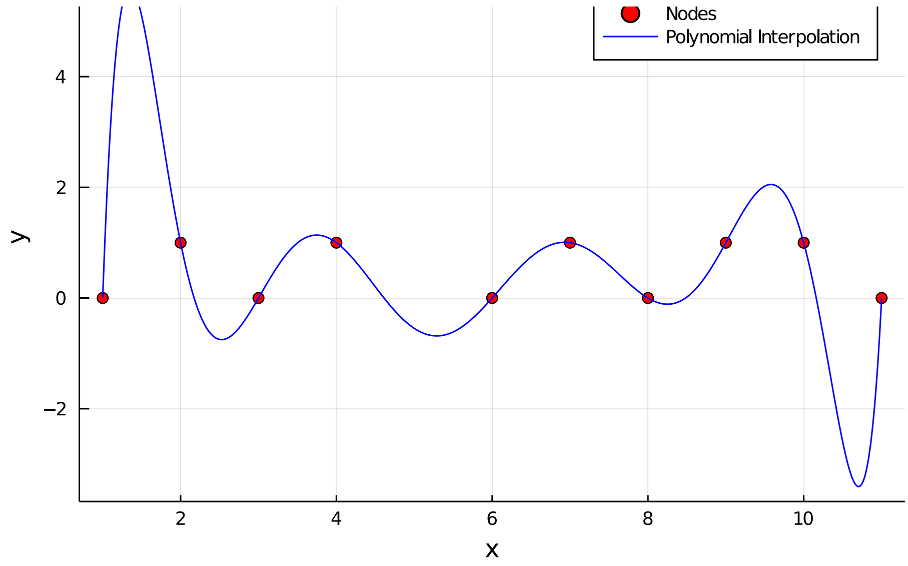

In [24]:
```
append!(X, [6 7 8])
append!(Y, [rand(0:1) rand(0:1) rand(0:1)])
plot(X,Y, color = :red, seriestype = :scatter, label = "Nodes", xaxis = "x", yaxis = "y")
plot!(PolynomialInterpolation(X,Y), color = :blue, label = "Polynomial Interpolation")
```

Out[24]:



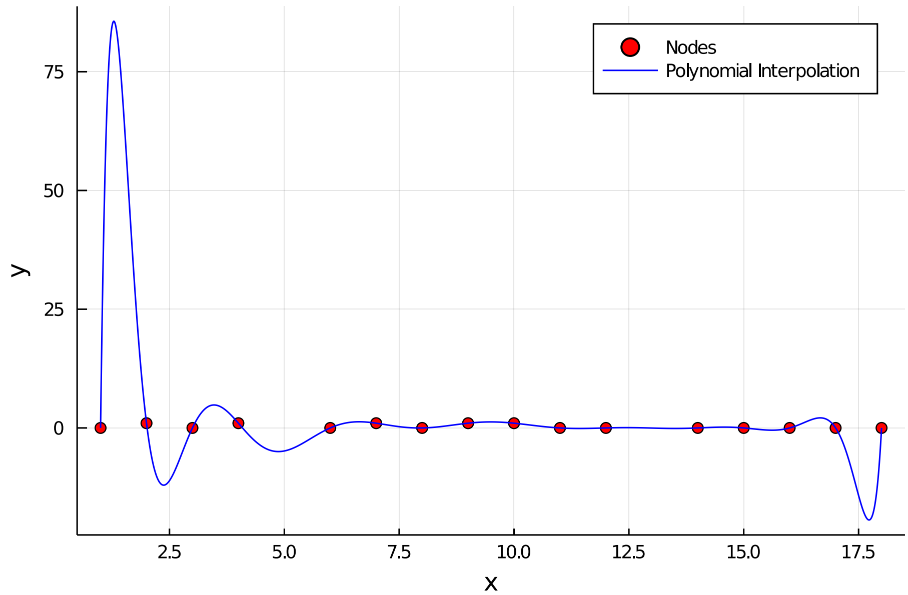

In [25]:
```
append!(X, [9 10 11])
append!(Y, [rand(0:1) rand(0:1) rand(0:1)])
plot(X,Y, color = :red, seriestype = :scatter, label = "Nodes", xaxis = "x", yaxis = "y")
plot!(PolynomialInterpolation(X,Y), color = :blue, label = "Polynomial Interpolation")
```

Out[25]:




In [26]:
```
append!(X, [12 14 15 16 17 18])
append!(Y, [rand(0:1) rand(0:1) rand(0:1)])
append!(Y, [rand(0:1) rand(0:1) rand(0:1)])
plot(X,Y, color = :red, seriestype = :scatter, label = "Nodes", xaxis = "x", yaxis = "y")
plot!(PolynomialInterpolation(X,Y), color = :blue, label = "Polynomial Interpolation")
```

Out[26]:




In [ ]:

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