Numerical Analysis
homework 08: Polynomial Interpolations

Due on Tuesday, April 25, 2017

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1 Introduction

When recording experiment data, we usually have no time to record densely. However, to get the value of certain range we skip, we need to use interpolation to find it out. In this homework, we will use **Lagrange Interpolation** to recover the waveform and compare it with the groundtruth data.

1.1 Lagrange Interpolation

Give a set of support points $\{(x_i, y_i), 0 \leq i \leq n\}$, then

$$F(x) = \sum_{i=0}^{n} y_i \prod_{k=0, k\neq i}^{n} \frac{x - x_k}{x_i - x_k} \tag{1}$$

where $F(x)$ is interpolated value of location x.

2 Implementation

Algorithm 1 Non-recursive Nevile's Algorithm

```
XS, YS is support data, x is location to interpolate.
NS = YS
for each k ∈ {1,...., n-1} do
    for each j ∈ {0,..., n-k-1} do
        NS[j] = ((x-XS[j])*NS[j+1]-(x-XS[k+j])*NS[j]) / (XS[j+k]-XS[j])
    end for
end for
return NS[0]
```

2.1 Complexity

From Algorithm 1, the double for-loop make the whole process a $\boldsymbol{O(n^2)}$ problem.

3 Discussion

In this section, we will discussion the folowing topics:

1. Experiment result of **f3.dat, f5,dat, f7,dat, f13.dat, f21.dat**
2. Maximum error against **f301.dat**, which is our groundtruth
3. Maximum error(x=550 to 700) against **f301.dat**, which is our groundtruth

3.1 Maximum Error

Table 1 shows the result of all dat.

	f3	f5	f7	f13	f21
Max Error(all)	372.866858	248.340631	379.107286	1283.4489	16728.5648
Max Error(550 to 700)	372.866858	233.364371	148.890794	39.618945	17.803983

Table 1: Max error of all dat