```
% APC 524 - Numerical Algorithms
% Homework #1
% Problem 2
clear all; close all; clc;
n = 30;
x = 5.5;

% Part (a) and (b)
p(1) = 1;
p(2) = 5.5;

for i = 2:n
    num = x;
    den = 1.0000;
    for j = 1:i-1
        num = round(num*x, 5, 'significant');
    end
    for j = 1:i
        den = round(den*j, 5, 'significant');
    end
    p(i+1) = round(num/den, 5, 'significant');
end

S(1) = p(1);
for i = 1:n
    S(i+1) = round(S(i)+p(i+1),5,'significant');
end
% The answer converges to 5 significant figures at n=17

S(end)
St = exp(5.5)
rel_err = abs(S(end) - St)/St

% Part (c)
S_c(1) = p(1);
for i = 2:n+1
    ans = p(i);
    for j = i-1:-1:1
        ans = round(ans+p(j), 5, 'significant');
    end
    S_c(i) = ans;
end
S_c(end)
% adding from right to left results in the same estimate of exp(5.5)
 at
% convergence (244.71). However, in this case it takes more terms in
 order
% to converge, and you need k=22 before you reach convergence.


ans =

                    244.71
```

```
St =

           244.69193226422


rel_err =

      7.38387065418834e-05


ans =

                    244.71
```

part d flip the odd index signs of p

```
p_n = p;
for i = 2:2:n
    p_n(i) = -p(i);
end

% part i
S_neg_i(1) = p_n(1);
for i = 1:n
    S_neg_i(i+1) = round(S_neg_i(i)+p_n(i+1),5,'significant');
end

S_neg_i(end)
exp(-5.5)
rel_err_i = abs(S_neg_i(end)-exp(-5.5))/exp(-5.5)
```

```
ans =

                0.0038363


ans =

       0.00408677143846407


rel_err_i =

        0.0612883402547712
```

part ii

```
S_neg_ii(1) = p_n(1);
for i = 2:n
    ans = p_n(i);
```

```
    for j = i-1:-1:1
        ans = round(ans+p_n(j), 5, 'significant');
    end
    S_neg_ii(i) = ans;
end
S_neg_ii(end)
rel_err_ii = abs(S_neg_ii(end)-exp(-5.5))/exp(-5.5)
```

```
ans =

                    0.004


rel_err_ii =

        0.0212322709431183
```

part iii

```
S_neg_iii(1) = p_n(1);
S_neg_iii(2) = round(p_n(1) + p_n(2), 5, 'significant');
S_neg_iii(3) = round(round(p_n(1) + p_n(3), 5, 'significant')...
    +p_n(2),5,'significant');
S_neg_iii(4) = round(round(p_n(1) + p_n(3), 5, 'significant')...
    +round(p_n(2)+p_n(4),5,'significant'),5,'significant');
for i = 5:n
    % compute odds/even
    ans_e = p_n(1);
    ans_o = p_n(2);
    for j = 3:2:i
        % evens
        ans_e = round(ans_e+p_n(j),5,'significant');
    end
    for j = 4:2:i
        ans_o = round(ans_o+p_n(j),5,'significant');
    end
    S_neg_iii(i) = round(ans_e+ans_o, 5, 'significant');
end
S_neg_iii(end)
rel_err_iii = abs(S_neg_iii(end)-exp(-5.5))/exp(-5.5)
```

```
ans =

     0


rel_err_iii =

     1
```

part iv

```
S_neg_iv(1) = p_n(1);
S_neg_iv(2) = round(p_n(2) + p_n(1), 5, 'significant');
S_neg_iv(3) = round(round(p_n(3) + p_n(1), 5, 'significant')...
    +p_n(2),5,'significant');
S_neg_iv(4) = round(round(p_n(3) + p_n(1), 5, 'significant')...
    +round(p_n(4)+p_n(2),5,'significant'),5,'significant');
for i = 5:n
    ans1 = p_n(i);
    ans2 = p_n(i-1);
    for j = i-2:-2:1
        ans1 = round(ans1+p_n(j), 5, 'significant');
    end
    for j = i-3:-2:1
        ans2 = round(ans2+p_n(j), 5, 'significant');
    end
    S_neg_iv(i) = round(ans1+ans2, 5, 'significant');
end
S_neg_iv(end)
rel_err_iv = abs(S_neg_iv(end)-exp(-5.5))/exp(-5.5)
```

```
ans =

                    0.01


rel_err_iv =

           1.4469193226422
```

Part (e)

```
S_neg_e = round(1./S, 5, 'significant');
S_neg_e(end)
rel_err_e = abs(S_neg_e(end)-exp(-5.5))/exp(-5.5)
```

```
ans =

                0.0040865


rel_err_e =

      6.64188022633233e-05
```

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