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clear all
%27
imax = 34;
nmax = 24;
tic;
timedur = toc;
for i=1:imax
    tic;

    if i <= nmax
        [Is(i),pi_me(i),pi_er(i),timepi(i),Vc,points]=Pi_spheref(2^i);
        if i == 14
            figure();
            plot3(Vc(1,points),Vc(2,points),Vc(3,points),'rx');
            hold on;
            plot3(Vc(1,~points),Vc(2,~points),Vc(3,~points),'b. ');
            hold off;
            legend('Points in','Points out','Location','Best');
            title('MC simulation data for Pi');
        end
    else
        nloops = 2^(i-nmax);
        %disp(num2str(nloops));
        [Ib,pi_meb,pi_erb,timepib,Vcb,pointsb]=Pi_spheref(2^nmax);
        sumbin = sum(pointsb);
        stdbin = std(pointsb);

        parfor ia=2:nloops
            %disp('In loop');
            [Ia,pi_mea,pi_era,timepia,Vca,pointsa]=Pi_spheref(2^nmax);
            %Ib = Ib + Ia;
            sumbin2(ia) = sum(pointsa);
            %stdbin2(ia) = sqrt((stdbin^2+std(pointsa)^2)/2);
            stdbin2(ia) = std(pointsa);
            timepib = timepib+timepia;
            %Vcb = Vcb + Vca;
            %pointsb = pointsb + pointsa;
        end
        sumbin = sumbin + sum(sumbin2);
        stdbin = sqrt((stdbin^2+sum(stdbin2.^2))/nloops);
        Ntotal = 2^i;
        pi_meb = 6*sumbin/(Ntotal); % The calculated values of Pi
        pi_erb = 6*stdbin/sqrt(Ntotal); %The Standard Error of Pi
        [Is(i),pi_me(i),pi_er(i),timepi(i),Vc,points] = deal(Ib,pi_meb,pi_erb,timepib,Vcb,pointsb);
    end
end

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        timedur=toc;
        timerem = timedur*(2^(imax-i+1)-1)/60;
        clc;
        fprintf('%.2f%% Completed, Estimated remaining time %.2f minutes',100*i/imax,timerem);
    end

    % [I_sorted, I_order] = sort(Is);
    % pi_me = pi_me(I_order);
    % pi_er = pi_er(I_order);
    % timepi = timepi(I_order);

    for o=1:imax
        fprintf('Calculated Pi is %.8f with a Standard Error of %.8f and actual Pi is %.8f \n',pi_me,pi_er,timepi);
    end

    figure();
    errorbar(2.^(1:imax),pi_me,pi_er,'o');
    title('Calculated value of Pi and errors');
    set(gca, 'XScale', 'log');
    set(gca, 'YScale', 'log');
    xlabel('Number of vectors');
    ylabel('Value of Pi');
    hold on;
    plot([2^1,2^imax],[pi,pi],'r--');
    legend('MC Pi','Pi','Location','Best');
    figure();
    yyaxis left;
    plot(2.^(1:imax),timepi);
    title('Total run time and error');
    set(gca, 'XScale', 'log');
    set(gca, 'YScale', 'log');
    xlabel('Number of vectors');
    ylabel('Time calculating Pi (s)');
    yyaxis right;
    plot(2.^(1:imax),pi_er);
    ylabel('Error in Pi');
    set(gca, 'YScale', 'log');
    legend('Time','Error','Location','Best');

    function [M,pi_me,pi_er,timeout,Vc,pointers]=Pi_spheref(N)

    %Calculate the value of Pi using MonteCarlo comparing the volumes of a
    %sphere and a cube
    tic;
    %N is the number of random vectros to create
    M=N;

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Vc = 2*rand(3,N)-1; %The 3D vectors in the (-1,1) region
Norm = sqrt(Vc(1,:).^2+Vc(2,:).^2+Vc(3,:).^2);%Magnitude of vectors
pointers = Norm<1;%The vectros with a magnitude less than 1, inside the sphere
% Vc_in = Vc(pointers);%The positions of the points inside the sphere
% Vc_out = Vc(1-pointers);%The points outside
pi_me = 6*sum(pointers)/N;% The calculate values of Pi
pi_er = 6*std(pointers)/sqrt(N); %The Standard Error of Pi
timeout=toc;
end

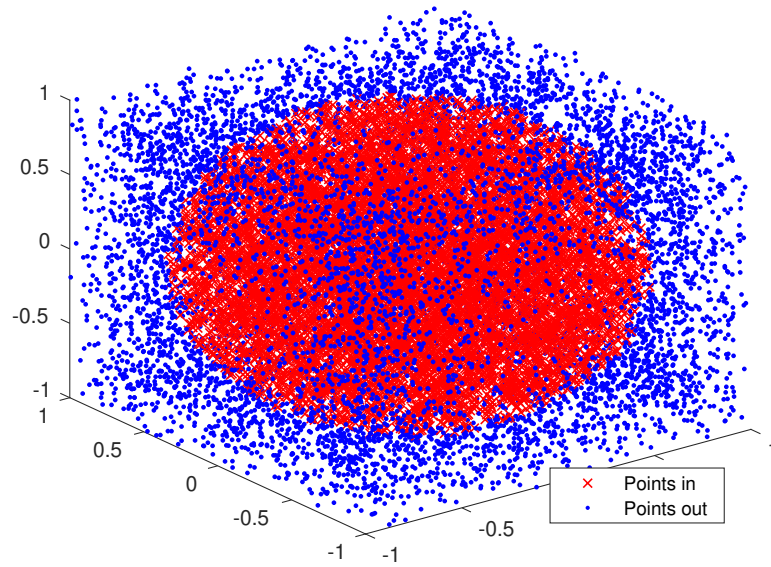
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2.94% Completed, Estimated remaining time 4252017.62 minutes5.88% Completed, Estimated rema
Calculated Pi is 1.50000000 with a Standard Error of 1.50000000 and actual Pi is 3.14159265
Calculated Pi is 3.00000000 with a Standard Error of 1.13389342 and actual Pi is 3.14159265
Calculated Pi is 4.50000000 with a Standard Error of 0.67082039 and actual Pi is 3.14159265
Calculated Pi is 2.43750000 with a Standard Error of 0.52925979 and actual Pi is 3.14159265
Calculated Pi is 3.00000000 with a Standard Error of 0.37796447 and actual Pi is 3.14159265
Calculated Pi is 3.51562500 with a Standard Error of 0.26224547 and actual Pi is 3.14159265
Calculated Pi is 3.37500000 with a Standard Error of 0.18639380 and actual Pi is 3.14159265
Calculated Pi is 3.16406250 with a Standard Error of 0.13251359 and actual Pi is 3.14159265
Calculated Pi is 3.38085938 with a Standard Error of 0.09303688 and actual Pi is 3.14159265
Calculated Pi is 3.04980469 with a Standard Error of 0.06629831 and actual Pi is 3.14159265
Calculated Pi is 3.15673828 with a Standard Error of 0.04681670 and actual Pi is 3.14159265
Calculated Pi is 3.12304688 with a Standard Error of 0.03311976 and actual Pi is 3.14159265
Calculated Pi is 3.14794922 with a Standard Error of 0.02340970 and actual Pi is 3.14159265
Calculated Pi is 3.15673828 with a Standard Error of 0.01655043 and actual Pi is 3.14159265
Calculated Pi is 3.13751221 with a Standard Error of 0.01170652 and actual Pi is 3.14159265
Calculated Pi is 3.14328003 with a Standard Error of 0.00827698 and actual Pi is 3.14159265
Calculated Pi is 3.14435577 with a Standard Error of 0.00585260 and actual Pi is 3.14159265
Calculated Pi is 3.14720535 with a Standard Error of 0.00413822 and actual Pi is 3.14159265
Calculated Pi is 3.14473343 with a Standard Error of 0.00292628 and actual Pi is 3.14159265
Calculated Pi is 3.14034462 with a Standard Error of 0.00206933 and actual Pi is 3.14159265
Calculated Pi is 3.14305401 with a Standard Error of 0.00146318 and actual Pi is 3.14159265
Calculated Pi is 3.14205694 with a Standard Error of 0.00103464 and actual Pi is 3.14159265
Calculated Pi is 3.14044547 with a Standard Error of 0.00073162 and actual Pi is 3.14159265
Calculated Pi is 3.14145023 with a Standard Error of 0.00051732 and actual Pi is 3.14159265
Calculated Pi is 3.14125451 with a Standard Error of 0.00036580 and actual Pi is 3.14159265
Calculated Pi is 3.14145362 with a Standard Error of 0.00025866 and actual Pi is 3.14159265
Calculated Pi is 3.14208392 with a Standard Error of 0.00018290 and actual Pi is 3.14159265
Calculated Pi is 3.14140635 with a Standard Error of 0.00012933 and actual Pi is 3.14159265
Calculated Pi is 3.14149252 with a Standard Error of 0.00009145 and actual Pi is 3.14159265
Calculated Pi is 3.14168158 with a Standard Error of 0.00006467 and actual Pi is 3.14159265
Calculated Pi is 3.14157585 with a Standard Error of 0.00004573 and actual Pi is 3.14159265
Calculated Pi is 3.14157859 with a Standard Error of 0.00003233 and actual Pi is 3.14159265
Calculated Pi is 3.14159870 with a Standard Error of 0.00002286 and actual Pi is 3.14159265

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MC simulation data for Pi



Calculated value of Pi and errors

